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THE
ISTHMUS OF SUEZ QUESTION.

THE
ISTHMUS OF SUEZ
QUESTION.

Rev. '38.

BY

M. FERDINAND DE LESSEPS,

MINISTER PLENIPOTENTIARY.

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*Explanation of the French Monies, Weights, and Measures
used in the following pages.*

- 1 Franc = about $9\frac{1}{2}$ d. or, 25 fr. = 1£.
- 81 Livres = 80 francs.
- 1 Quintal = about $220\frac{1}{2}$ lbs.
- 1 Metre = $39\frac{1}{8}$ inches nearly.
- 1 Kilometre = about $1093\frac{2}{3}$ yards, or nearly 5 furlongs.
- 1 Hectare = 2 acres, 4712. or nearly $2\frac{1}{2}$ acres.
- 1 Litre about $1\frac{3}{4}$ pint.

The figures following the denomination are decimal parts ;
thus : 7 *fr.* 25, 6 *met.* 50. represent respectively $7\frac{1}{4}$ *francs*,
 $6\frac{1}{2}$ *metres*.

THE ISTHMUS OF SUEZ QUESTION

SUBMITTED TO THE PUBLIC OPINION

OF ENGLAND.

“Aperire terram gentibus.”

IN the month of October, 1854, I left Europe for Egypt, in consequence of an invitation I had received from the new Viceroy, Mohammed Saïd, who for twenty years has honoured me with his friendship. I had no mission from my Government. It was in the course of a journey across the Libyan desert from Alexandria to Cairo which I made in company with the Prince, that the question of cutting through the Isthmus of Suez, was for the first time mooted between us. He requested me to draw up a memorial on the subject, (Appendix, No. 1) and, as my ideas met with his approbation, he issued to the Consuls General of foreign powers a firman (Appendix, No. 2), destined to receive the sanction of the Sultan, granting to a company composed of the capitalists of all nations without distinction, the right to construct a canal between the two Seas. Mr. Bruce, the agent of the British Government, was the

first of the Consuls General who was informed of the Viceroy's project, so that France and England received intimation of it at the same time.

MM. Linant Bey and Mougel Bey, engineers, who have been engaged, the one for the last twenty, the other for the last thirty years, in the construction of important hydraulic works in Egypt, were appointed by the Viceroy to accompany me in an exploring expedition to the Isthmus of Suez, and to complete, by a fresh examination of the ground, the investigations they had already made.

This expedition was made during last December and January; after presenting an account of it to His Highness Mohammed Saïd, I gave instructions (Appendix, No. 3), in his name, to the engineers, calculated to assist them in the preparation of their report.

In the month of March, MM. Linant Bey and Mougel Bey delivered the precursory scheme (Appendix, No. 4), which quite convinced the Viceroy of the possibility of executing this great undertaking in which he has taken the initiative. They establish by calculations and data, which may be verified by any one, that a maritime canal direct from Suez to Pelusium thirty leagues long, one hundred metres wide, and eight metres deep, extending sufficiently far into the two seas by means of jetties, to obtain

the depth necessary to enable ships to enter without difficulty, having an inland port in the natural basin of Lake Timsah, and which should be completed in six years, would cost, at the most, 160,000,000 francs, (£6,400,000); or, about half the amount expended on the Great Northern railway from London to York, or on that between Paris and Lyons.

In a journey that I made to Constantinople,*

* I think it to the purpose to insert here a letter, which I addressed to Lord Stratford de Redcliffe, Her Britannic Majesty's Ambassador, on my leaving Constantinople:—

Pera, 28th February, 1855.

“ There are questions which require to be boldly met in order to be well resolved, as there are wounds which must be opened in order to be healed. The frankness with which you received my first remarks upon a subject, the gravity of which I do not affect to disguise, encourages me to submit to your consideration a point of view from which it appears to me advisable to contemplate the question of the Isthmus of Suez. The great influence which your character and your long experience naturally give you the right to exercise in the decisions of your Government on all Eastern questions, makes me especially anxious to neglect no opportunity of enabling Your Excellency to form an opinion from a perfect acquaintance with the case.

The results already obtained from the intimate alliance of France and England, testify sufficiently to the advantages that the European balance and civilization in general derive from that union of the two peoples. The future and the welfare of all the nations of the universe are therefore concerned in maintaining intact, in preserving from any attack, a state of things, which, to the everlasting honour

I ascertained that the Sultan and his ministers were favourable to the project, and I delivered

of the Governments that have brought it about, can alone, with time, ensure the blessings of progress and of peace to the human race. Thence the necessity of getting rid, beforehand, of all causes of rupture, or even of coolness, between the two peoples; thence, consequently, the paramount duty of anticipating amongst future contingencies, those circumstances calculated to awake ancient feelings of antagonism, and to raise, in the bosom of either nation, those emotions against the violence of which, the wisdom of Governments is powerless to struggle. The motives for hostile rivalry are tending successively to give place to that generous emulation which gives birth to great things.

Looking at the situation of affairs in a general way, it is scarcely to be perceived upon what ground and upon what occasion, those struggles, which so long desolated the world, could be renewed. Is it financial and commercial interests that could cause division between the two peoples? Why, British capital thrown into all the undertakings of France, and the immense developement of international commerce, have established ties between them which become closer every day. Is it political interests and questions of principle? Why, the two nations have but one common aim, one same ambition: the triumph of right over might, of civilization over barbarism. Is it, finally, a sordid jealousy of territorial extension? Why, they acknowledge, at the present time, that the globe is vast enough to offer to the spirit of adventure that animates their respective populations, countries to make available, human beings to withdraw from the state of barbarism; and, moreover, from the moment that their flags wave together, the conquests of the one profit by the activity of the other.

At the first glance, then, nothing is perceived in the general state of affairs that could impair our cordial relations with England.

to the Viceroy a letter from the Grand Vizier, in which he aptly characterized the opening of

If, however, we look closer, an eventuality presents itself which, causing the most enlightened and most moderate cabinets to partake in popular prejudices and passions, is capable of reviving old antipathies, and of compromising, with the alliance, the benefits to be derived from it.

There is, in fact, a point of the globe with the free passage of which the political and commercial power of Great Britain is bound up, a point, the possession of which France had, on her part, aspired to in former times. This point is Egypt, the direct route from Europe to India, Egypt bathed once and again with French blood.

It is superfluous to define the motives which would not allow England to see Egypt in the possession of a rival nation without opposing it by the most energetic resistance; but what should also be taken into serious consideration, is, that with less positive interests, France under the dominion of her glorious traditions, under the impression of other feelings more instinctive than rational, and therefore more powerful over the impressionable spirit of her inhabitants, would not, in her turn, leave to England the peaceable sovereignty of Egypt. It is clear that, so long as the route to India is open and certain, that the state of the country ensures the facility and promptitude of the communications, England will not set about creating the most grave difficulties by appropriating a territory which, in her eyes, has no other value than as a means of transit. It is likewise evident that France—whose policy, for the last fifty years, has been to contribute to the prosperity of Egypt, both by her counsels and by the concourse of a great number of Frenchmen distinguished in the sciences, in administrative capacity, in all the arts of peace or war—will not seek to realize, in this direction, the projects of another epoch, so long as England does not interfere.

But let one of those crises occur which have so often

the Isthmus of Suez by a maritime canal as a work of the most useful and interesting charac-

shaken the East, let a circumstance arise wherein England should find herself under the rigorous necessity of taking a position in Egypt to prevent another power from forestalling her, and tell us then if it is possible that the alliance could survive the complications which such an event would occasion. And why should England consider herself obliged to become mistress of Egypt, even at the risk of breaking her alliance with France? For this single reason, that Egypt is the shortest and most direct route from England to her Eastern possessions; that this route must be constantly open to her; and that, in whatever concerns this mighty interest, she could never temporise. Thus, from the position given to her by nature, Egypt might still become the subject of a conflict between France and Great Britain; so that this chance of rupture would disappear if, by a providential event, the geographical conditions of the ancient world were changed, and, that the commercial route to India, instead of passing through the heart of Egypt, were removed to its confines, and, being opened to all the world, could never be exposed to the chance of its becoming the exclusive privilege of any one.

Well! this event, which must have been the design of Providence, is now within the reach of man. It may be brought about by human skill. It is to be realized by the cutting of the Isthmus of Suez, an undertaking to which nature opposes no obstacle, and wherein English capital, as well as that of other countries, will certainly take part.

Let the Isthmus be cut through, let the waves of the Mediterranean mingle with those of the Indian Ocean, let the Railroad be continued and completed, and Egypt, in acquiring an increased importance as a productive country, as a country of internal commerce, as a general storehouse and common transit, loses its dangerous pre-eminence as an uncertain and contested passage of communication.

ter. (Appendix, No. 5.) His Highness immediately transmitted to the Divan, the documents, maps, and plans necessary for understanding the question of construction, and which were required for obtaining the sanction of the Sovereign.

I was then commissioned to return to Europe for the purpose of calling public attention to the subject and to take measures for organizing the undertaking, on a cosmopolitan basis in accordance with the principles which have from the commencement guided the projectors.

Prince Mohammed Saïd has declared in his instructions (Appendix, No. 6), that the labours of his engineers, who at this moment are engaged in preparing their definitive scheme,

The possession of its territory being no longer an object of interest to England, ceases to be a possible bone of contention between that power and France, the union of the two peoples is for the future unalterable, and the world is preserved from the calamities which a rupture between them would produce. This result affords such securities for the future, that it is sufficient to point them out, to attract to the undertaking destined to produce it, the sympathy and the encouragement of the Statesmen whose efforts are directed to the settlement of the Anglo-French alliance upon an immoveable basis. You, my Lord, are one of those Statesmen, and you have too large a share in questions of high policy, to which I am a stranger, for me not to entertain the wish to communicate to you my aspirations.

FERD. DE LESSEPS."

shall be submitted to the judgment of engineers, chosen from England, from France, from Holland, from Germany, and from Italy ; and that the organization of the Universal Company entrusted with the construction of the Canal shall be based upon the scientific decision of Europe.

Until then no call will be made on the shareholders, and, the administration of the Company being in the hands of capitalists and other persons of all nations, in proportion to the relative commercial importance of their country, they will not support the undertaking unless they are convinced that it will be to their interest to do so.

As England is evidently interested more than any other power in the construction of a canal through the Isthmus of Suez, my first step has been to come to London, both in order to ascertain the state of public opinion in England on this question, and also to give to all who desire it such information as will enable them fully to appreciate the moral and material aspects of the undertaking.

I have already remarked with satisfaction that, in general, men of intelligence with whom I have had the honour of conversing on the subject, do not admit that an event which would advance the interests of the whole world, could possibly do injury to the power or commerce of England. They frankly discard all idea of a prejudice against the project ; they assert on

the contrary, that if feasible their country cannot but gain by it, and that it would be a source of regret if the idea were entertained in France that what would be beneficial to other countries should not be of equal benefit to England.

Objections, however, which to my mind, I am proud to acknowledge, do honour to the candour of English politicians, have been made, in perfectly good faith, and without any feeling of distrust towards a friendly nation, the alliance with which, cemented by the blood of their brave armies, has been recently sanctioned by the unanimous demonstration of the English people, as it will shortly be by the people of France.

I shall reproduce these objections, and reply to them in very few words.

I begin by setting aside all those which relate to the supposed impossibility of execution, and to the idea that the canal can only be constructed at an expenditure out of proportion to the advantages reasonably to be expected.

If the canal should be found to be physically impossible, of course the scheme will not be entertained, and if European science should not make it clear that the advantages to be derived are commensurate with the expenses to be incurred, capitalists will not come forward.

The report of the engineers replies triumphantly to other objections respecting the sands

of the desert, the alluvial deposits at Pelusium and Suez, and the navigation of the Red Sea.

It has been affirmed that the project of a canal might retard the construction of a railway from Alexandria to Suez, which the policy of England has always considered essential to her Indian interests.

Far from being retarded by the canal project, the railway will, on the contrary, be indebted to this very design, for its speedy completion; for it can only obtain sufficient returns from the activity occasioned by a considerable maritime commerce across the Isthmus of Suez. The Egyptian Government, which has already completed, at its own expense, the first two sections of the railway, viz., from Alexandria to the Nile, and from the Nile to Cairo, takes this view of the question, and is at the same time desirous of giving satisfaction to England, whose main object is to secure for her despatches and travellers the most direct and speedy route. The Viceroy, being thus persuaded, that of the two undertakings, the railway and the canal, each forms the complement of the other, has just decided on the completion of the third section, from Cairo to Suez. He has given the order for the rails to an English house, and engineers are at this moment engaged in levelling and in the superintendence of the earth-works.

It has also been said that if a considerable

number of European workmen, or agricultural labourers, were taken to the Isthmus of Suez, there would be some fear of their forming a colony of natives of one single country—of France for instance—which might have a prejudicial effect on the policy of England. In the first place, there is no motive for a universal company to employ, for a special political object, workmen of any one country in preference to those of any other. Again, it is not necessary to demonstrate that a company of capitalists will attend to their own interests, and they will certainly have an incontestable advantage in employing Egyptians only, as workmen and agricultural labourers. The *fellah* of Egypt has alone constructed, under the direction of skilful and experienced engineers and foremen, all the extensive works undertaken in that country, and no nation can more easily, or on more favourable terms, furnish disciplined armies, of robust, active, and intelligent workmen, equally fit for the construction of canals, for hydraulic and for agricultural operations.*

But what is of greater moment, and indeed alone deserves the consideration of a people who have the fortunate custom of interesting them-

* These very sensible observations are taken from a correspondence which appeared in the "Times" of the 13th June last.

selves in their political affairs, is the apprehension conscientiously entertained by statesmen, whose right and whose duty it is to ask themselves and maturely to consider:—

1. Whether shortening the distance by 3000 leagues for all the countries of Northern Europe, and by 3400 leagues on an average for the ports of the Mediterranean, including Malta, may not in future, in case of war, menace the safety of the British possessions in India.

2. Whether the commercial and maritime relations of Great Britain will not be disadvantageously affected by the opening of a new route, which, while shortening the distance for her own navigation, will at the same time facilitate and increase the navigation of all other nations towards the extreme East.

The following passage from a recent publication replies to these objections:—

“ The power in possession of Aden opens and
 “ shuts at its will the Red Sea, and if it is true
 “ that the influence of nations and governments
 “ chiefly depends on the good they can do to
 “ their friends and the harm they can do to
 “ their enemies, that revolution would be of no
 “ slight advantage to England which would lead
 “ the principal current of the world’s commerce
 “ under the guns of her ships and the batteries
 “ of her fortresses. Besides, is it from the naval
 “ armaments of the Mediterranean that Eng-

“ land has most reason to fear an invasion of
 “ India? It requires no more than ordinary
 “ foresight to perceive, that if her Indian pos-
 “ sessions were ever seriously threatened, it
 “ could only be from Russia by land, and from
 “ North America by sea. In either case, the
 “ safety of her possessions would depend on the
 “ shortening of her line of operations.

“ India is not the only British possession to
 “ which the route will be abridged by the pas-
 “ sage *viâ* Suez. Australia will profit no less
 “ by the change; and it will be all the more
 “ necessary to facilitate the defence of that
 “ country, as it will become, if the cutting
 “ through of the Isthmus of Panama be ef-
 “ fected, more accessible to the ships of war
 “ of the United States.

“ We may conclude from these observations,
 “ that there would be small risk of the opening
 “ of the Isthmus of Suez weakening the mili-
 “ tary power of Great Britain. Her commercial
 “ power could only be compromised by it, if it
 “ were possible for the multiplicity of her tran-
 “ sactions with the East Indies to be decreased
 “ by shortening the intervening distance by
 “ 3000 leagues, or if it were possible for the
 “ producers and sellers of the commodities of
 “ the extreme East to lose by the consumption
 “ of them in Europe being doubled.

“ If England must gain by the opening of

“ the Isthmus an increase of military and com-
 “ mercial power, the genius of calculation within
 “ her will soon triumph over an ill-considered
 “ opposition. She will not sacrifice the positive
 “ elevation, the basis of which is enlarged by
 “ the developement of what surrounds it, to
 “ that relative elevation which is satisfied with
 “ the degradation of others, and she will not
 “ give any one the right to attribute to her,
 “ with regard to all the nations bordering on
 “ the Mediterranean, the language lately ad-
 “ dressed by the Emperor Nicholas to the Eng-
 “ lish Minister on the subject of Greece, and of
 “ the East. Such a policy she leaves to its fitting
 “ home. She does more, she opposes it by
 “ force of arms. Convinced that her strength
 “ lies in her power of expansion, and in her
 “ commercial capabilities, she endeavours by
 “ the prosperity of her neighbours to enlarge
 “ the basis of her own, and for this reason it
 “ is that she animates with her co-operation so
 “ many enterprises which enrich the Continent ;
 “ no undertaking that she has ever assisted will
 “ prove more productive of beneficial results to
 “ herself than the operations at the Isthmus of
 “ Suez.”

To the preceding quotation, which is conclusive, I add some figures which also have their value.

The Mediterranean ports will profit, it is true,

by the opening of the Isthmus of Suez, but England with the 5,000,000 tons employed in her commerce—a tonnage greater than that of all the navies of Europe, including France, united—cannot fail to profit in a much greater degree by the increase of relations which must necessarily result from the shortening of the distance between the points of traffic; to this opening moreover she will be indebted for the inestimable advantage of finding herself in closer connection with her colonies, than another nation whose competition might otherwise be really formidable in the eyes of the upholders of an exclusive system.

But on the contrary, England, adopting the policy of commercial freedom, has been seen to favour the attempts which have been made to cut through the American Isthmus, although, if successful, it would bring the United States nearer the British possessions in India and still nearer to Australia. She is not, however, ignorant of the fact that the maritime commerce of the United States, which twenty years ago employed only 1,000,000 tons, now, in 1854, requires no less than 5,400,000, and that this vast tonnage, already larger than her own, is constantly increasing. But England on her part does not remain at a stand-still, and she has done well in showing no fear of the contest. The law of progress has been justified by official

statistical documents. The burthen of the English ships built in 1842 was 130,000 tons ; in 1843, shipping to the amount of 203,000 tons was built. It is especially since the relations of the United States with the Indian Seas have been extended, that the commerce of Great Britain has in those very regions experienced a still farther developement. Thus, the imports from the Indian Peninsula, which in 1849 amounted to £9,238,000, had in 1853 increased to £13,610,000. Those from China, which in 1849 were £6,200,000, rose in 1853, to £8,300,000. Again, the tonnage employed in the trade between Great Britain and her Eastern possessions, including the other countries in the Indian Seas, to and fro, amounted in 1849 to 967,076, and in 1853 to 1,595,133 tons.

It may perhaps not be superfluous to reply to those persons who still believe in the supposed monopoly which they think it advisable for England to retain in her commerce with the East ; we have just seen that there is in fact no such monopoly as far as the United States are concerned, and that England does not suffer from the want of it. It is the same with respect to Europe. This state of things has a tendency to increase every day, even with the existing means of communication by the Cape of Good Hope and the imperfect transit through Egypt. Marseilles, Bordeaux, Havre, Genoa,

Trieste, Amsterdam, Rotterdam, and Hamburg, all despatch vessels direct to the Indies. Marseilles and Trieste now receive, *viâ* Egypt, cases of indigo from India and bales of silk goods from China. Powerful companies, in anticipation of peace, are at this moment engaged in building ships expressly for trading to the East, or else in devoting to that purpose the steamers and sailing vessels now used as transports in the Black Sea.

Other objections have been made, and as they have been seriously brought forward, I cannot allow them to pass without remark. Some very modest Englishmen have compared their country to Venice, and have contended, that if Venice lost her power by the discovery of the Cape of Good Hope, England would see hers decline by a return to the shortest route. In the first place, the shortest route is a geographical fact which no one can get rid of, and, from the moment that it is ascertained that no material obstacle prevents the opening of this direct line, it will not be for any Government, much less for the one which has inaugurated the era of commercial freedom, to oppose the realization of a work which will satisfy the interests of all. Then, Great Britain in the nineteenth century cannot be compared to Venice in the fifteenth: the latter, in consequence of her defeats in 1291 and 1298, had been obliged to

cede the supremacy to Genoa, and, after having still shone in the first rank when she put herself at the head of the league against Charles VIII. (1495), finally lost her preponderance when the Portuguese destroyed her fleets in the Red Sea, and the Emperor, the Pope and the kings of France and Arragon formed the league of Cambray against her (1508). It would be useless to prove by historical evidence that the decline of the Queen of the Adriatic was due to other causes than the discovery of the Cape (1497), by which she might have profited as well as the Portuguese, if she had had the same elements of strength and vitality. Trieste, which has succeeded to her commercial prosperity, and even surpassed it, has had no need of the re-establishment of the ancient route to India. If Trieste participates largely, as is to be hoped, in the advantages of the Isthmus Company, if her neighbour of the Adriatic finds therein a new life, Great Britain will lose nothing thereby. Has it ever been seen that a capital city, brought into communication with a great market by a railroad, has had to regret the shortening of the distance and the amelioration of its own relations, because some secondary towns on the line were nearer to the market and participated in the common benefit?

Marseilles, Trieste, Greece, the ports of Italy, of Spain and of Turkey, are nearer to Egypt

than London and Liverpool. Well; in the present state of the relations of Europe with Alexandria, England absorbs to herself alone *half the value* of the commerce between all other countries and Egypt, and her tonnage comprises *two-thirds* of the navigation to and fro under all flags.

I wrote the following from Cairo, December 3rd, 1854, to a friend of mine, a member of the British Parliament.

“ Some persons assert that the Viceroy of
 “ Egypt’s project will meet with opposition in
 “ England. I cannot believe it: your states-
 “ men are too enlightened for me to entertain
 “ such a supposition under present circum-
 “ stances. What! England herself transacts
 “ more than half the general commerce with
 “ India and China; she has an immense em-
 “ pire in Asia; she may reduce by one-third
 “ the charges on her commerce, and bring that
 “ Eastern Empire nearer by one-half; and she
 “ would not allow it to be done. Wherefore?
 “ To prevent the Mediterranean nations from
 “ taking advantage of their situation to increase
 “ their commerce in the Eastern Seas,—she
 “ would deprive herself of the immense advan-
 “ tages which must accrue to her, in material
 “ respects, and in a political point of view,
 “ from this new communication, solely because
 “ others are more favourably situated than her-

“ self, as if geographical position was all-in-all,
 “ and as if, everything considered, England
 “ had not more to gain by this work than all
 “ the nations together. Finally, England, it is
 “ said, must dread the reduction in the number
 “ of vessels employed in Indian commerce which
 “ would result from the diminution of more
 “ than one-third in the duration of the voyage.
 “ And has not England proved in her expe-
 “ rience of railways, by results which have sur-
 “ passed the boldest anticipations, that the
 “ necessary consequence of shortening the dis-
 “ tance and diminishing the duration of a jour-
 “ ney, is the infinite augmentation of intercourse
 “ and circulation. One cannot understand why
 “ those who entertain this fear do not advise
 “ the English Government to direct, that the
 “ voyage to India now shall be *viâ* Cape Horn,
 “ for that would employ still more ships than
 “ the way by the Cape of Good Hope and
 “ furnish better sailors.

“ If, as is not unlikely, the difficulties with
 “ which I am threatened should be brought
 “ forward, public opinion, so powerful in Eng-
 “ land, will soon do justice to interested oppo-
 “ sition and superannuated objections.”

Her Majesty's Government concluded with
 the United States, on the 19th of April, 1850,
 a treaty of neutrality for the projected canal
 through the American Isthmus. The cabinets

of London and Paris are now on such intimate terms as to make it a matter of no difficulty for them to agree upon a convention, if it suited their political interests to do so, relative to the passage of the Isthmus of Suez, assimilating it to that of the Dardanelles. The other powers would not fail to give in their adhesion to the convention, which would be open to them.

In this manner commercial navigation would be guaranteed against the chances of war, and military armaments could neither remain in nor pass through the Isthmus without the permission of the Sovereign of the country.

The question of the importance to the commercial interests of Great Britain of cutting through the Isthmus of Suez, has been considered in the most favourable light by the principal men of science, engineers, economists, and public writers of England. I shall quote hereafter the opinions of Mr. Anderson, the present director of the Peninsular and Oriental Company, and of Captain James Vetch, R. E., from their respective works. (Appendix, Nos. 8 and 9.) The fact of the question having been frequently treated with favour by the press, seems to show that it has already been accepted by the feeling of the country; the remarkable extract from the "Papers for the People" in the memorial of the engineers (Appendix, No. 4) will be read with interest. The celebrated no-

velist, Charles Dickens himself, has not disdained to devote several eloquent pages to a very practical consideration of the project for constructing a canal through the Isthmus of Suez.

It is to be remarked that the English authors who have written upon this question, have, without exception, advocated the direct line from Suez to Pelusium. This view is taken by all the inhabitants of Egypt, and I doubt if the indirect line, complicated as it is by traversing the Nile, would have been adopted by two of my compatriots so distinguished as M. Baude and M. Paulin Talabot, if they had themselves been on the spot before they gave their opinions.

The *Moniteur Universel* of France, in the Number for the 6th of July, has proved the advantage of the direct track over the indirect one. I refer my readers to that article (Appendix, No. 9).

It is incumbent on me to add, that, although the two tracks may be entertained, theoretically speaking, practically only one is now to be thought of; for the Viceroy of Egypt, who consents to the cutting of the Isthmus, has a perfect right to refuse to allow the whole of Egypt to be cut through. He has, in his written instructions, specially charged me to make known his declaration, which is in the following terms :—

“ After having passed in review the numerous projects submitted to various Governments or to the public for more than fifty years, I grant perfect liberty for the application of those means that science shall recognise to be best to bring the Red Sea and the Mediterranean into communication at any point of the Isthmus, eastward of the course of the Nile ; but I declare that I will not authorize the Grand Maritime Suez Canal Company to adopt any track which shall have its point of departure on the Mediterranean coast, to the west of the Damietta branch, and which shall traverse the course of the Nile.”

If it were necessary, reference might be made to the East India Company, the merchants of Australia, of Singapore, of Madras, of Calcutta and of Bombay, the commercial houses of the City, the shipowners of London and Liverpool, the manufacturers of Manchester, the proprietors of iron mines, the manufacturers of machines, the Peninsular and Oriental Steam Navigation Company, the directors of banks and of extensive industrial undertakings, the Chambers of Commerce, the proprietors of coal-fields, who in 1854 exported 1,309,251 tons of coal, of the value of £2,127,156, an amount which, immense as it already is, will be still farther increased, and to a considerable extent, by the opening of the Isthmus of Suez.

I appeal to their interests, and leave the decision to their judgment.

Lastly, the objection has been made, that the canal project would not be received with favour by the Turkish Government; but, like every question in which the principle is just, the consequences are infallible; and from whatever point of view we regard this question of the Isthmus of Suez, we see nothing but universal benefit arise from it.

As I have already remarked, I met with no opposition at Constantinople on the part of the Porte. Turkey is aware that the Canal of the two Seas is destined to add to her power and prosperity, by bringing Constantinople nearer by 4300 leagues to the Indian Ocean, and by facilitating the communication with the Holy Places of Arabia, the source of the authority the Sultan possesses over his Mussulman population.

Turkey can rise from her present languor only by borrowing capital and intelligence from Europe. The prosperity of the East is intimately connected at the present day with the interests of civilization in general, and the most effectual means of working its welfare, in connection with that of humanity, is to break down the barriers that still separate individuals, races, and nations.

War and commerce have civilized the world.

War will have played out its part with that last effort which is being made under our eyes. The victories hereafter to be gained will be those of commerce only. Let us exert ourselves to open up for her a new route. This object may be pursued and attained—in the words of a great writer—“ *A travers les orages et les ténèbres de la guerre.*” (*Guizot.*)

Let us bring the populations of Polynesia, of Australia and China, of the Indies and of Africa, nearer to Europe ; let us make them participators in the blessings of civilization.

To accomplish this great undertaking, we appeal to all religious and intelligent men, for it is worthy of their sympathy and co-operation.

We invoke the support of all statesmen, because in the establishment of new and easy means of communication between the two hemispheres all nations are interested. Lastly, we will address ourselves to the capitalists, when they have satisfied themselves of the pecuniary advantages to be derived from the undertaking.

FERD. DE LESSEPS.

London, July, 1855.

MEMORIAL ADDRESSED TO HIS HIGHNESS

MOHAMMED SAID,

VICEROY OF EGYPT.

The Camp, Marea, in the Lybian Desert,
15th November, 1854.

THE junction of the Mediterranean and the Red Seas, by a navigable canal, is an undertaking the utility of which has attracted the attention of all the great men who have reigned in, or conquered, Egypt: Sesostris, Alexander the Great, Julius Cæsar, the Arab Conqueror Amrou, Napoleon I. and Mehemet Ali.

A canal, communicating with the Nile, was in existence in ancient times; first, for a period of 100 years, down to about the middle of the ninth century before the Hegira; secondly, for a period of 445 years, from the reign of the first successors of Alexander the Great, down to about the fourth century before the Hegira; thirdly and lastly, for a period of 130 years after the Arabian conquest.

Napoleon, upon his arrival in Egypt, immediately organized a commission of engineers to ascertain whether it would be possible to re-establish that ancient channel of navigation: the question was resolved in the affirmative, and when the learned M. Lepère delivered to him the report of the commission, on the eve of his return to France, he said: "It is

an important affair, it is not now in my power to accomplish it, but the Turkish Government will perhaps one day owe its preservation and its glory to the execution of this project."

The moment has now arrived to realize Napoleon's prediction. The work of cutting through the Isthmus of Suez is certainly destined, more than any other, to contribute to the preservation of the Ottoman Empire, and to demonstrate to those who have been wont to proclaim its decay and ruin, that it still has a productive existence, and that it is capable of adding a brilliant page to the history of the world's civilization.

Why have the governments and the peoples of the West combined to uphold the Sultan in the possession of Constantinople, and why has he who has thought fit to menace that position met with the armed opposition of Europe? Because the passage from the Mediterranean into the Black Sea is of so much importance, that whatever European Power might become master of it would domineer over all the rest, and destroy that balance which the whole world is interested in preserving.

Do but establish at another point of the Ottoman Empire a similar, and a yet more important position; do but make Egypt the highway of the commercial world by cutting through the Isthmus of Suez; and thereby you will create in the East another immoveable seat of power; for, as far as the new passage is concerned, the great powers of Europe, from fear of seeing it one day seized upon by one amongst them, will regard the necessity of guaranteeing its neutrality, as a question of vital importance.

M. Lepère fifty years ago required 10,000 workmen, four years' labour, and from 30 to 40,000,000 francs for the construction of the Suez Canal, but upon a plan which would now be insufficient for the demands of commerce and navigation; and his idea was the possibility of a direct cutting through the Isthmus towards the Mediterranean.

Prior to the year 1840, some skilful English Engineers, who were employed in levelling operations in the Isthmus, had the honour of first ascertaining that no difference existed between the levels of low water in the Mediterranean and in the Gulf of Arabia.

M. Paulin Talabot, one of the three distinguished Engineers chosen in 1847 by a society for the investigation of the Isthmus of Suez,* (and who also had important operations in levelling executed by M. Bourdaloue,) had adopted the indirect route from Alexandria to Suez: availing himself of the barrage for the passage of the Nile, he estimated the entire cost at 130,000,000 francs for the Canal, and 20,000,000 for the port and roadstead of Suez.

M. Linant *Bey*, who for the last thirty years has ably conducted canal works in Egypt, has made the question of the Canal of the *two Seas* the study of his life on the spot itself. He was appointed in 1853 to direct fresh levelling operations, and has proposed to cut through the Isthmus in an almost direct line at its narrowest part, establishing a large inland port in the basin of Lake *Timsah*, and making the channels from Pelusium, and from Suez,

* The other two were Mr. Stephenson for England, and M. Négrelli for Austria.

into the Mediterranean and the Red Sea, available for the largest vessels.

The General of engineers, Gallice *Bey*, on his part, submitted to Mehemet Ali a proposal for a direct cutting across the Isthmus. M. Mougel *Bey*, director of the Nile barrage-works, and chief engineer of bridges and highways, also submitted to Mehemet Ali the possibility and utility of cutting through the Isthmus of Suez; and, in 1840, at the request of Count Walewsky, at that time an envoy in Egypt, he was instructed to take preliminary measures which political events did not allow to be carried out.

A thorough examination will decide which of the lines is most suitable; and, as the undertaking has been acknowledged to be practicable, it only remains to make a choice. Whatever the opérations that may be necessary, and however difficult, they will not intimidate modern art; their success can be no matter of doubt at the present time: it is a question of money, which the spirit of enterprise and association will not fail to resolve, provided the benefits resulting from it are in proportion to the outlay.

It is easy to demonstrate that the cost of the Canal of Suez, admitting the highest estimate, is not out of proportion with the utility and the profits of this important work, which would curtail by more than one-half the distance of India from the principal countries of Europe and America. This result is made obvious in the following Table, drawn up by M. Cordier, professor of Geology:—

LIST OF EUROPEAN AND AMERICAN PORTS.

	<i>Distance to Bombay in leagues:</i>	<i>Vid the</i>	
	<i>Vid Suez</i>	<i>Atlantic</i>	<i>Difference.</i>
Constantinople .	1.800	6.100	4.300
Malta	2.062	5.800	3.778
Trieste	2.340	5.960	3.620
Marseilles . .	2.374	5.650	3.276
Cadiz	2.224	5.200	2.976
Lisbon	2.500	5.350	2.850
Bordeaux . . .	2.800	5.650	2.850
Havre	2.824	5.800	2.976
London	3.100	5.950	2.850
Liverpool . . .	3.050	5.900	2.850
Amsterdam . .	3.100	5.950	2.850
St. Petersburg .	3.700	6,550	2.850
New York . . .	3.761	6.200	2.439
New Orleans . .	3.724	6.450	2.726

With such figures before us, comment is useless; they show that all the nations of Europe, and even the United States of America, are alike interested in the opening of the canal of Suez, as well as in the rigorous and inviolable neutrality of that thoroughfare.

Mohammed Saïd clearly comprehends that there is no undertaking within his power, which, from its immensity and the utility of its results, could bear comparison with that which I propose to him. What a splendid title to fame for him! What an everlasting source of wealth for Egypt!

The pilgrimage to Mecca henceforth assured and facilitated to all Mussulmans; an immense impulse given to steam navigation and to distant voyages; the countries on the coasts of the Red Sea and the Gulf of Persia, the eastern coast of Africa, India,

the kingdom of Siam, Cochin China, Japan, the vast empire of China, with its more than 300,000,000 of inhabitants, the Philippine Islands, Australia and that immense Archipelago, towards which the emigration from old Europe is directed, brought nearer by nearly 3000 leagues to the Mediterranean Sea and the north of Europe : such are the sudden and immediate effects of cutting through the Isthmus of Suez.

It has been calculated that the European and American navigation, *viâ* the Cape of Good Hope and *viâ* Cape Horn, may carry on a yearly traffic of 6,000,000 tons, and that on the half only of that tonnage the world's commerce would realize a benefit of 150,000,000 francs annually, by sending the ships *viâ* the Gulf of Arabia.

There is no doubt that the canal of Suez will occasion a considerable increase of tonnage ; but in reckoning only upon 3,000,000 tons, there will yet be an annual produce of 30,000,000 francs by collecting dues of ten francs per ton, which might be reduced in proportion to the increase of navigation.

After having indicated the financial advantages of the undertaking, let us consider its general political advantages, which we believe to be equally incontestable.

Everything that results in contributing to the extension of the commerce, of the industry, and of the navigation of the world, is especially advantageous to England, a power which stands foremost amongst all others from the importance of its navy, from the productions of its manufactories, and from its commercial relations.

A deplorable prejudice, based upon the political antagonism which so long and so unhappily existed between France and England, has alone accredited the opinion that the opening of the canal of Suez, so useful for the interests of civilization and of the common weal, could damage those of England. The alliance of the two nations which rank highest in the scale of civilization, an alliance which has already proved the possibility of solutions hitherto reckoned impossible by vulgar tradition, will, amongst its other numerous benefits, allow us to investigate with impartiality this mighty question of the Canal of Suez, to form an exact estimate of its influence upon the prosperity of nations and to consider it heresy to believe, that an undertaking calculated to halve the distance between the Western and Eastern hemispheres of the globe, should not be suitable for Great Britain, the mistress of Gibraltar, Malta, the Ionian Islands, Aden, important stations on the east coast of Africa, India, Singapore, and Australia.

England, as well as France, and even more so, must wish to see a cutting through that strip of land of thirty leagues, which no one who pays attention to the subject of civilization and progress can behold upon the map, without feeling the most ardent wish for the disappearance of that only obstacle that Providence has left in the highway of the world's traffic.

The railway, by itself, is not sufficient; it will never acquire any substantial importance, and will only be assured of its revenues when it has become the auxiliary of the maritime Canal of Suez. The completion of the railway, so useful to travellers, and so justly desired by England, will then become

a necessity, and will no longer be a heavy charge upon the Egyptian Government.

Germany will also hail all the efforts for the construction of the Canal across the Isthmus. It will be to her the complement to the free navigation of the Danube. Prince Metternich, who for more than twenty years has interested himself in the cutting of the Canal of the two Seas, and Baron de Bruck, one of the promoters of the investigations made in 1847, saw that in this question lay the aggrandizement of Trieste and of Venice, as well as the opening of important outlets for the produce of the Imperial provinces, and of the kingdom of Hungary, where the projected canal from the Danube to Kustendje, on the Black Sea, in the line of the ancient trench or rampart of Trajan, will facilitate exportation.

Russia will find in the opening of the Canal of Suez a just satisfaction of that national aspiration towards the East which led her on one occasion to extend the limits of her vast Empire to the confines of British India, and, on another, to threaten the integrity of Turkey. The mission of civilization devolving upon the Czar over the numerous tribes of whom he is arbiter, may yet suffice the noblest ambition; the new outlets which will be pacifically thrown open to their activity and to their necessity of expansion, will be more profitable to them than a policy of conquest and exclusive dominion which it is now no longer possible for any one nation to carry on triumphantly.

The United States of America, whose traffic with Indo-China and Australia has for many years im-

mensely developed itself; Spain with the Philippine Islands; Holland with Java, Sumatra and Borneo; the towns formerly so flourishing on the coasts of Italy; the ports and islands of Greece; all the nations in short which have held or hold a high maritime and commercial position; will hasten to take part in a work which will augment their wealth, or create new sources of it, and to the success of which I believe I can promise His Highness Mohammed Saïd the active and energetic co-operation of the enlightened men of all countries.

(Signed) FERD. DE LESSEPS.

FIRMAN OF CONCESSION.

OUR friend Mons. Ferdinand de Lesseps, having called our attention to the advantages which would result to Egypt from the junction of the Mediterranean and Red Seas, by a navigable passage for large vessels, and having given us to understand the possibility of forming a company for this purpose composed of capitalists of all nations; we have accepted the arrangements which he has submitted to us, and by these presents grant him exclusive power for the establishment and direction of a Universal Company, for cutting through the Isthmus of Suez, and the construction of a canal between the two Seas, with authority to undertake or cause to be undertaken all the necessary works and erections, on condition that the Company shall previously indemnify all private persons in case of dispossession for the public benefit. And all within the limits, upon the conditions and under the responsibilities, settled in the following Articles.

ARTICLE I.

Mons. Ferdinand de Lesseps shall form a company, the direction of which we confide to him, under the name of the UNIVERSAL SUEZ MARITIME CANAL COMPANY, for cutting through the Isthmus

of Suez, the construction of a passage suitable for extensive navigation, the foundation or appropriation of two sufficient entrances, one from the Mediterranean and the other from the Red Sea, and the establishment of one or two ports.

ARTICLE II.

The Director of the Company shall be always appointed by the Egyptian Government, and selected, as far as practicable, from the shareholders most interested in the undertaking.

ARTICLE III.

The term of the grant is ninety-nine years, commencing from the day of the opening of the Canal of the two Seas.

ARTICLE IV.

The works shall be executed at the sole cost of the Company, and all the necessary land not belonging to private persons shall be granted to it free of cost. The fortifications which the Government shall think proper to establish shall not be at the cost of the Company.

ARTICLE V.

The Egyptian Government shall receive from the Company annually fifteen per cent. of the net profits shown by the balance sheet, without prejudice to the interest and dividends accruing from the shares which the Government reserves the right of taking upon

its own account at their issue, and without any guarantee on its part either for the execution of the works or for the operations of the Company ; the remainder of the net profits shall be divided as follows :—Seventy-five per cent. to the benefit of the Company, ten per cent. to the benefit of the members instrumental to its foundation.

ARTICLE VI.

The tariffs of dues for the passage of the Canal of Suez, to be agreed upon between the Company and the Viceroy of Egypt, and collected by the Company's agents, shall be always equal for all nations ; no particular advantage can ever be stipulated for the exclusive benefit of any one country.

ARTICLE VII.

In case the Company should consider it necessary to connect the Nile by a navigable cut with the direct passage of the Isthmus, and in case the Maritime Canal should follow an indirect course, the Egyptian Government will give up to the Company the uncultivated lands belonging to the public domain, which shall be irrigated and cultivated at the expense of the Company, or by its instrumentality.

The Company shall enjoy the said lands for ten years free of taxes, commencing from the day of the opening of the canal ; during the remaining eighty-nine years of the grant, the Company shall pay tithes to the Egyptian Government, after which period it cannot continue in possession of the lands above

mentioned without paying to the said Government an impost equal to that appointed for lands of the same description.

ARTICLE VIII.

To avoid all difficulty on the subject of the lands which are to be given up to the Company, a plan drawn by M. Linant *Bey*, our Engineer Commissioner attached to the Company, shall indicate the lands granted both for the line and the establishments of the maritime Canal and for the alimentary Canal from the Nile, as well as for the purpose of cultivation, conformably to the stipulations of Article VII.

It is moreover understood, that all speculation is forbidden from the present time, upon the lands to be granted from the public domain, and that the lands previously belonging to private persons and which the proprietors may hereafter wish to have irrigated by the waters of the alimentary Canal, made at the cost of the Company, shall pay a rent of . . . per *feddan* cultivated (or a rent amicably settled between the Government and the Company).

ARTICLE IX.

The Company is farther allowed to extract from the mines and quarries belonging to the public domain, any materials necessary for the works of the canal and the erections connected therewith, without paying dues ; it shall also enjoy the right of free entry for all machines and materials which it shall import from abroad for the purposes of carrying out this grant.

ARTICLE X.

At the expiration of the grant the Egyptian Government will take the place of the Company, and enjoy all its rights without reservation, the said Government will enter into full possession of the Canal of the two Seas, and of all the establishments connected therewith. The indemnity to be allowed the Company for the relinquishment of its plant and moveables, shall be arranged by amicable agreement or by arbitration.

ARTICLE XI.

The statutes of the Society shall be moreover submitted to us by the Director of the Company, and must have the sanction of our approbation. Any modifications that may be hereafter introduced must previously receive our sanction. The said statutes shall set forth the names of the founders, the list of whom we reserve to ourselves the right of approving. This list shall include those persons whose labours, studies, exertions or capital have previously contributed to the execution of the grand undertaking of the Canal of Suez.

ARTICLE XII.

Finally, we promise our true and hearty co-operation, and that of all the functionaries of Egypt in facilitating the execution and carrying out of the present powers.

TO MY ATTACHED FRIEND
M. FERDINAND DE LESSEPS,
OF HIGH BIRTH AND ELEVATED RANK.

Cairo, 30th of November, 1854.

The grant made to the Company having to be ratified by his Imperial Majesty the Sultan, I send you this copy that you may keep it in your possession. With regard to the works connected with the excavation of the Canal of Suez, they are not to be commenced until after they are authorized by the Sublime Porte.

3 Ramadan, 1271.

(*The Viceroy's Seal.*)

A true translation of the Turkish text.

KÆNIG BEY,

Secretary of Mandates to his Highness
the Viceroy.

Alexandria, May 19th, 1855.

INSTRUCTIONS

TO

MM. LINANT BEY AND MOUGEL BEY,

For the Scheme of a Maritime Canal from the Red Sea to the Mediterranean, and an Alimentary Canal derived from the Nile.

Cairo, January 15, 1855.

HAVING just finished the exploration confided to us by his Highness Mohammed Saïd Pacha, I think it right to direct the attention of MM. Linant *Bey* and Mougel *Bey* to the principal points intended to serve as a programme to the precursory scheme which we have agreed to present, as a preliminary to a more complete report, accompanied by plans, maps, sections, estimates, and other documents in explanation.

1. For the entrance on the Red Sea side ; to show what works it will be necessary to execute, as jetties, reservoirs, sluices, &c. if the present port is made use of. To settle the direction of the channel from the present anchorage of the roads of Suez, to the entrance of the Canal.

2. To show the exact direction of the Canal from

Suez, to that part of the ancient basin of the Red Sea called the *Bitter Lakes*.

3. To explain how it is intended to take advantage of this basin, and whether, in passing through it, the Maritime Canal is to have one or two banks, or not to have any at all.

4. To lay down the continuation of the Canal as far as the basin of Lake Timsah, which is intended to serve as an inland port.

5. Works to be performed in rendering Lake Timsah fit for the object proposed. To give the length of the quay walls. In its passage through Lake Timsah, the Canal must be excavated of a greater breadth than in the rest of its course, in order to allow the vessels to lay at the quays without obstructing the passage. These quays are to be established, as far as possible, in the neighbourhood of the fresh water canal.

6. Course of the Maritime Canal from Lake Timsah to Lake Menzaleh.

7. The works to be executed along Lake Menzaleh, or in the lake itself, for the course of the Canal.

8. Is the opening of the Canal into the Mediterranean to be at the opening of the ancient Pelusiatic branch?

9. To specify particularly the kind, nature, and dimensions of the works that will have to be executed in jetties, moles, breakwaters, reservoirs, retaining basins, &c. in order to obviate the objections made up to the present time, as to the difficulties or alleged impossibilities, proceeding from alluvial deposits on the coast, and the choking up of the open-

ing of a Canal into the Mediterranean. This part of the scheme must be based upon incontestable proofs, exemplifications, and calculations.

10. What is the bulk of water that will enter the Maritime Canal from the Red Sea at each tide?

11. What advantage may be derived from the height of the tides, both in the course of the Maritime Canal, in the basin of the Bitter Lakes, and at the Pelusiac mouth?

12. To calculate for the Maritime Canal at a breadth of 100 *metres* at the level of low water in the Mediterranean, with liberty to reduce it to sixty-five or seventy *metres*, in those few instances where the necessary excavations and removals would be too considerable. The water line, or depth, is to be calculated at six, at seven, and at eight *metres*, all below the level of low water in the Mediterranean, in order that the Company may choose, according to the expense, that one of the three depths which shall be most advantageous to its interests, combined with those of the navigation.

13. To obviate the objections relative to the difficulties of navigation in the Red Sea and in the Gulf of Pelusium.

14. To make a rough estimate of the *maximum* of all the expenses, and to state the probable date when the Canal can be opened for navigation.

15. To accompany the scheme of the Maritime Canal, with a scheme for a Canal of communication, of alimentation, and irrigation derived from the Nile, taking its point of departure between the barrage and Boulak, to reach the *Wady*, and come as far as Lake Timsah. The dimensions shall be

so calculated, that, taking into account its fall and its supply, the Canal may water at least 100,000 feddans at the time of the inundation, and from 20 to 30,000 during the low water of the river. In the vicinity of Lake Timsah, with which it will communicate, this Canal is to be divided into two branches, for simple irrigation ; the first to be directed towards Suez, the other towards Pelusium.

16. To examine whether the sands of the downs on the Isthmus, will occasion any obstacle to the construction and maintenance of the Canal, and how they may be turned to account by means of the Irrigating Canal.

17. To furnish a *maximum* estimate of the secondary Canal derived from the Nile, and to state the length of time required for the works.

18. To give an account of the nature and quality of the materials, which can be easily, and without great cost of transport, applied in the whole of the works, and also the localities from whence they are to be obtained.

19. Finally, to furnish an approximate statement of the *minimum* anticipated revenues, of the grand Maritime Canal, and of the Canal of alimentation and interior navigation.

I do not mean to confine the labours of MM. Li-nant *Bey* and Mougel *Bey*, within the mere limits indicated in this programme.

While bearing witness to the good understanding that I have observed to exist between them, and the identity of their convictions, as to the possibility of the communication between the Red Sea and the Mediterranean, by a Canal accessible to large vessels,

I beg them, in case the opinion of either, upon any question whatever, should not be entertained by the other, to state the difference of their views, and to assign the reasons thereof.

Finally, the precursory scheme, accompanied by an explanatory map, is to be finished as quickly as possible.

(Signed) FERD. DE LESSEPS.

EXTRACT FROM THE MEMORIAL
 OF MM. LINANT *BEY* AND MOUGEL *BEY*,
 ENGINEERS TO THE VICEROY OF EGYPT,*

*By way of Precursory Scheme for cutting through
 the Isthmus of Suez, by a direct Maritime Canal
 from Pelusium to Suez.*

THE enlightened Prince who now governs Egypt, Mohammed Saïd Pacha, wishing to withdraw the question of cutting through the Isthmus of Suez from the uncertainties of theory, and to bring it into practical reality, has granted a firman by which he concedes to the Universal Company formed by the capitalists of all countries, who are freely willing to take part in the undertaking, the construction and working of a Maritime Canal between the Red Sea and the Mediterranean, with an additional Canal for communication and irrigation, derived from the Nile.

Dictating himself the terms of the Firman of Concession, Prince Mohammed Saïd has required that

* As the work of the Viceroy's Engineers will be published, an extract only is here given, which will suffice to make known the importance of their labours, and show the practical results of their investigations.

the undertaking shall be complete, and that an attentive examination of the localities be made, in order to profit by all the advantages offered by nature. He has recommended that the shortest track be followed, the least expensive, and that which will admit of the largest ships. His early studies and his experience in nautical art, have perfectly prepared him for the comprehension of all the bearings of the scientific question. He has indicated Pelusium and Suez, as the extreme points of the cutting to be made in that narrow tract of land, which presents a longitudinal depression across the Isthmus, of thirty leagues, and which is formed by the meeting of the two plains descending with a gradual slope, the one from Egypt, the other from the frontier hills of Asia. He considers that nature has herself traced out the communication between the two Seas, in the line of this depression.

Towards Lake Timsah, situated at an equal distance from Suez and Pelusium, another not less remarkable furrow meets the longitudinal depression at right angles; it is that of the *Wady Tomilat* (the fruitful land of Goshen of Scripture). This furrow still receives, for a considerable length, the overflowings of the Nile, and also appears to form the natural track of a canal of communication, commencing at the river and proceeding to connect itself in the central part of the Isthmus, with the grand line of navigation to be established between the Arabian Gulf and the Mediterranean.

The Maritime Canal will thus be brought into communication with the heart of Egypt, by a fresh water canal, which will receive the same navigation

as the Nile, and will serve also for the irrigation of large zones of the desert, exhibiting at present the most wild and desolate aspect.

Upon these data we have been instructed to make a preliminary report.

Before giving the results of our investigations, it has appeared necessary to us to justify the idea of a direct track between the two Seas; for this line never having been executed, although it is the most natural, it might be supposed that whenever the junction of the two Seas has been attempted, such difficulties have been met with, that it has been obliged to be relinquished; but this is by no means the case, as we shall presently show.

In fact, what M. Lebeau says in his *Histoire du Bas Empire* (tom. xii., p. 490), following Abulfeda, Prince of Syria, historian and geographer, who was living in the year 753 of the Hegira, is as follows:—

“ The coast at Farma (a town a little to the east
 “ of Pelusium, on the Mediterranean) was only
 “ seventy miles (106,000 *metres*) distant from the
 “ Red Sea. This space was a very smooth plain,
 “ slightly elevated above the level of the two Seas.
 “ Amrou formed the design of uniting them by a
 “ canal, which he would have filled with the waters
 “ of the Nile; but Omar having opposed it, from
 “ fear of opening an entrance into Arabia for the
 “ ships of the Christians, Amrou turned his thoughts
 “ in another direction. There was an ancient canal,
 “ called Trajanus Amnis, which Adrian caused to be
 “ brought from the Nile near to Babylon, in Egypt,
 “ as far as Pharboëtus, now Belbeis. He met at

“ this place with another canal, commenced by
 “ Nechos, and continued by Darius Hystaspes, and
 “ the two together discharged themselves into a la-
 “ goon of salt water, at the outlet of which Ptolemy
 “ Philadelphus caused a large trench to be made,
 “ which conducted the waters as far as the town of
 “ Arsinoë, or Cleopatris, at that part of the Gulf
 “ where Suez now is.

“ The whole of this canal, being filled up with
 “ sand, had become useless at the time of the famous
 “ Cleopatra. Amrou was not deterred by the an-
 “ cient prejudice, which, supposing the waters of
 “ the Red Sea to be higher than the soil of Egypt,
 “ created a fear of opening a passage for them ; and
 “ he made it navigable for the transport of the corn
 “ of Egypt into Arabia. It is that which is now
 “ called Khalig, which passes through Cairo, but it
 “ only goes as far as the lagoon called the Lake of
 “ Sheib. The remainder, as far as the Red Sea, is
 “ entirely filled up, although some traces of it are
 “ still distinguishable.”

We have thought it necessary to quote the entire passage, because it clearly establishes the question of the Canal, and certain facts to which we shall return hereafter.

After Amrou came the Sultan, Mustapha III., *who took great interest in the scheme for the junction of the two Seas by the Isthmus of Suez*, and who intended to execute this work at a time of peace. (See *Mémoires sur les Turcs*, by M. De Tott, Parts iii. and iv.)

M. Lepère proposed, it is true, the track of the secondary canal between Alexandria and the inte-

rior of Egypt ; but his opinion upon the direct track by the Isthmus of Suez is expressed in these terms :—

“ In this project of the Canal of Suez, we have
 “ expressly based the choice of the ancient direction
 “ by the interior of the Delta towards Alexandria,
 “ upon commercial considerations peculiar to Egypt,
 “ and upon the fact that the coast near Pelusium
 “ does not appear to allow of a permanent maritime
 “ establishment. Nevertheless, we think it right
 “ to acknowledge, that, waving these considerations,
 “ it would still be easy (although, on the contrary,
 “ it appeared difficult, and even dangerous, before
 “ the invention of locks) to open a direct communi-
 “ cation between Suez, the Bitter Lakes, and the
 “ Ras-el-Moyeh, continued upon the eastern bank
 “ of Lake Menzaleh, as far as the sea near Pelu-
 “ sium.

“ We think that a canal opened in this direction
 “ would have an advantage *which the interior canal*
 “ *would not*. In fact there might be constant navi-
 “ gation upon it, which would not be subject to the
 “ alternations of the rising and decreasing of the Nile.
 “ It would be easy to maintain a greater depth in it
 “ than in the first canal, by means of a current fed
 “ by the immense reservoir of the Bitter Lakes. . .
 “ I will add, that if I did not perceive
 “ some difficulties in excavating, and maintaining at
 “ a proper depth, the channel between Suez and the
 “ roadstead, I would propose to establish a direct
 “ communication of the two Seas by the Isthmus, for
 “ the use of corvettes and even of frigates, which
 “ would become the complement of this grand and
 “ important operation.”

It will be seen then, that M. Lepère himself acknowledged, that the direct track was the most advantageous for the commerce of the world, while the interior Canal was especially advantageous to Egypt. It is evident that with the two Canals, the one direct, on a large section, the other on a small section and derived from the Nile, all interests are most abundantly satisfied.

We will finish these observations by quoting the opinion of two distinguished staff-officers, MM. Galinier and Ferret, who have surveyed and well investigated the Red Sea. They have given a clear, rapid, and judicious analysis of the question.

“ It is not in the accomplishment of this project
 “ (the interior canal), that the real junction of the
 “ two Seas consists. This problem will not be re-
 “ solved, until the Isthmus shall present a practicable
 “ opening, by which all ships may pass without un-
 “ loading. In order to this, it must be operated
 “ upon directly from Pelusium to Suez ; on this line
 “ the desert is narrower than anywhere else. It is
 “ also in this direction, that the great depression of
 “ which we have spoken extends, and at the bottom
 “ of which the grand basin of the Bitter Lakes is
 “ situated. Everything therefore points out this
 “ spot in the strip of land for the construction of a
 “ canal. Everything, with one single exception,
 “ which is, that there is not, they say, any port at
 “ the extremity of this line of navigation ; that of
 “ Suez is partly filled up with sand, and upon the
 “ Mediterranean, not a harbour, not a single road-
 “ stead, which now affords any safety. Yet more,
 “ some travellers have stated, that if it were required

“ to form a port, it would be necessary to contend
 “ against masses of sand, which, continually shifted
 “ from west to east by a tolerably rapid current,
 “ seem to oppose any maritime establishment upon
 “ that coast. In fact it is, they say, for this reason
 “ that Alexander laid much farther to the west the
 “ foundations of the town which bears his name, and
 “ which he wished to become the emporium of the
 “ world. But is the objection very serious at the
 “ present time? can the obstacle, which occasions
 “ this anxiety, resist the constructive means which
 “ are at the disposal of our engineers? We think
 “ not. To create a port without the assistance of
 “ nature ; to put a restraint upon the sea ; to reduce
 “ it to subjection ; to impose upon it an artificial
 “ roadstead ; and to maintain that roadstead, in spite
 “ of the natural causes operating to destroy it : is a
 “ problem which has ceased to terrify modern art.

“ Let us take the port of Pelusium,—see how
 “ easily the difficulty would be removed ! Suppose
 “ the Bitter Lakes to be filled with the waters of the
 “ Arabian Gulf ; by the action of the tides alone,
 “ more than 700,000,000 cubic *metres* of water
 “ might be turned to account, the velocity of which
 “ would constantly scour the channel, and prevent
 “ the accumulation of sand at its mouth.

“ After all that has been done by printing, the
 “ mariner’s compass, steam,—the nineteenth cen-
 “ tury, by the realization of this vast undertaking,
 “ would again change the face of the globe. But, not
 “ to carry our views and our anticipations so far, in
 “ a zone nearer at hand, Arabia and Abyssinia, the
 “ vast country of the Gallas, the deserts of the

“ western coast of the Red Sea, with their roving
 “ populations, attached by powerful ties to the vast
 “ circle of traffic which our continent unceasingly
 “ creates and feeds—will enter into the pale of the
 “ European world. Navigation and industry charged
 “ with the supply of immense countries destitute of
 “ everything, will take a more extensive range. In
 “ the wake of commerce, enlightenment and civili-
 “ zation will penetrate, by degrees, that dreary night
 “ which envelopes the Mussulman world.”

The advantage of the new track being thus sufficiently proved from a general point of view, we shall now enter into the details of the scheme with regard to its execution. We will begin with the levelling of the line from Pelusium to Suez. These levels were taken by some engineers attached to the French expedition, and the difference between the level of high water at Suez, and of low water at Tineh, was found to be 9 *met.*, 90, in favour of the Red Sea. Although this result has been explained by geological and historical considerations, the fact appeared so extraordinary that several travellers came to the spot to verify it. Some English officers amongst others, operating first with the barometer, and afterwards with the boiling water process, were not able to discover any perceptible difference between the levels of the two Seas. These investigations, published in a pamphlet which has come before us, and which were known to the learned world, had occasioned much uncertainty, when, in 1847, a society established for the investigation of the Isthmus of Suez, and at the head of which were MM. Négrelli, Robert Stephenson and Talabot, caused a complete

survey to be made by French engineers, under the direction of M. Bourdaloue, well known for his improved methods of levelling, and his numerous labours in that particular branch. These able and experienced surveyors, provided with good instruments, and accompanied by a numerous staff, were formed into several divisions, which operated separately, and thus were able to obtain divers verifications.

To give still greater facility and more security to the operations of the engineers, His Highness the viceroy, who had generously provided for all the requirements of the expedition, condescended to make choice of one of us to direct the whole of the operations, with the assistance of a brigade of Egyptian Engineers and a Company of artillerymen, who assisted in all the operations of levelling and verification.

M. Talabot, the engineer, in a report published in 1847, has entered into all the details of these operations, and has given an irrefutable proof of the results obtained. As these results differed very widely from those obtained by the engineers of the French expedition, it was difficult to believe in so great an error.

M. Sabatier, Consul General of France in Egypt, having been informed of the wish of some learned Frenchmen to have a fresh verification, spontaneously applied to the viceroy of Egypt, and one of us was appointed to undertake it in consequence.

The verification was made in 1853. It resulted in favour of the surveyors of 1847. For, the new levels only differ 0 *met.*, 1814, from those of 1847,

and give as the difference of level between the station on the quay of the hotel at Suez, and low water in the Mediterranean 2 *met.*, 4286, instead of 2 *met.*, 6100. found by the operations in 1847.

There cannot be a moment's hesitation in making choice between the levellings of 1799 and those of 1847 and 1853, for the two latter were taken under the most favourable circumstances by experienced surveyors provided with the best instruments, and were verified several times without finding any perceptible difference by these various verifications ; whilst the levelling of 1799 was undertaken in the midst of the vicissitudes and dangers of warfare, in a hostile country, and in a climate to which the engineers were not accustomed. One part of the operations was performed with the spirit level ; another rather important portion could only be done with the water level ; the surveyors frequently differed ; none of the divisions of these levellings could be verified ; and if the last operations had been retarded ever so little, the incidents of the war would have made them impossible ; the operations had to be performed with rapidity, and the levels taken in long lengths ; with frequent interruptions, and without the check of any verification. This is what M. Lepère has stated in his memorial, where he expresses himself thus :—

“ Pressed for time, disturbed by the hostile demonstrations of the Arab tribes, frequently obliged to suspend operations, obliged in fine to take a great part of the observations with a water level, with no possibility of making any verification, it is not at all surprising that the able engineers who conducted these operations under such exceptional

“ circumstances should have arrived at uncertain “ results.” We have therefore adopted the levels taken in 1847 and in 1853, as the only true ones, the only ones that were verified, and the only satisfactory ones. We give an abstract of them in the following table :—

STATIONS WITH THE LEVELS TAKEN IN 1853, COMPARED WITH
THE LEVELS TAKEN AT THE SAME STATIONS IN 1847.

STATIONS.	Taken from low water in the Mediterranean at Tineh.		Variation from the Levels of 1847.
	1853.	1847.	
Low water in the Mediterranean at Tineh. }	0 m. 0000	0 m. 0000	0 m. 0000
Stations of the German Engineers at Tineh. }	1 m. 5586	1 m. 7400	0 m. 1814
Station at the Staff 29 L. 1853, point 26 of Bourdaloue's triangulation of the most elevated Lagoons of Lake Menzaleh at Ras el Ballah. }	1 m. 9800	1 m. 9800	0 m. 0000
Station 4 L. 1853, Bourdaloue's point A, which was found and verified. }	7 m. 8210	7 m. 4300	0 m. 3910
Bourdaloue's Station Staff at the mouth of the Canal (this staff is not certain). }	3 m. 8280	3 m. 0800	0 m. 7480
Station 3 L. 1853, at the Serapeum, or Bourdaloue's No. 83. }	16 m. 5950	16 m. 2300	0 m. 3650
Upon the most elevated deposits in the basin of the Isthmus. }	2 m. 4100		
	2 m. 0300		
Station 2 L. 1853, and Bourdaloue's Station B. 30, on a block of petrified wood, covered with sandy secretions, placed upon the deposits in the basin of the Isthmus. }	1 m. 8600	1 m. 8000	0 m. 0600
	2 m. 4380	2 m. 1100	0 m. 3280
Station 1 L. 1853, at the Persepolitan monument, upon a block of sandstone, south of the Bourdaloue excavations. }	11 m. 6300	11 m. 3700	0 m. 2600
Station on the Caravan Road, at the Staff Station, 3 L. 1853. }	2 m. 3900		
Station at the staff at the starting point No. 1, L. 1853. }	1 m. 5186		
Station on the quay of the Suez hotel, the same as that of M. Bourdaloue. }	2 m. 4286	2 m. 6100	0 m. 1814

The most striking fact to be observed in the examination of this table is, the slight relief of the ground

above high water of the Red Sea, in the whole extent of the Isthmus. There are only two points somewhat elevated. The first, proceeding from Suez, is met with before Lake Timsah, and is that which we shall call the Serapeum bar; its greatest elevation is 16 *met.*, 5950, above low water in the Mediterranean. The second point is at the outlet of the lake, and its greatest elevation is fifteen *metres*, at the spot known as the bar of *El Guisr*; but the line of the Canal may be carried in a direction where but ten *metres* are met with for some *kilometres* of length. Supposing therefore the bed of the canal to be established at the depth of 6 *met.*, 50, below low water in the Mediterranean, the greatest excavation would be at the bar of *El Guisr*, and would show a total depth of 16 *met.*, 50, which is nothing extraordinary; supposing it even twenty *metres*, the requisite excavation would bear no comparison with what was executed in Mexico, during the Spanish occupation. For, in their then difficult position, and in the absence of tools and improved means, the Spaniards were able to effect, near the town of Mexico, which was threatened with invasion by the waters of the neighbouring lakes, the cutting of Huehuetoca, the total length of which is 20,585 *metres*, and its depth from forty-five to sixty *metres*, for a length of more than 800 *metres*, and from thirty to fifty *metres* for a length of 3500 *metres*. And yet the expense of this work was only 31,000,000 francs.

The levelling also shows, that by adopting 6 *met.*, 50, for the bed of the Canal, there will be a length of 18 *kil.* in the Bitter Lakes, where there will not be a shovelful to remove, and for another 18 *kil.* there

will be very little to do ; and as these lakes are dry at a depth of 8 *met.*, 39, below low water, all the earth-works for the whole length of them could be performed in the dry, if found advantageous to do so.

The numerous transverse sections taken with the levelling of 1847, enable us to ascertain approximately the superfice of the Bitter Lakes at the water line. This superfice is about 330,000,000 *square metres*. If, then, the action of the tide, which brings two *metres* of moving water, be admitted into these lakes, a disposable volume of 660,000,000 *cubic metres* of water would be accumulated, and which might be raised to 800,000,000 by adding Lake Timsah and the retaining basins at Suez and Pelusium to these immense reservoirs.

Before pointing out the various directions of the adopted track, it appears necessary to arrive at a fixed opinion as to the formation of the Isthmus and of the downs by which it is partly covered, and also as to the accumulations of sand which exist both on the coast of Pelusium and at the bottom of the Gulf of Suez ; for it is from the explanation of these phenomena that we shall start in our justification of the arrangements of the direct track in general and in detail.

By attentively observing what is passing before our eyes at the present time, in respect of the destruction and recomposition of continuity, we may come to an exact conclusion regarding the laws which operated towards the first ages of the world in the formation of alluvial lands.

Let us first examine what is going on in the English Channel ; for this narrow sea having a large

number of ports both on the French and English coasts, has on that account been the object of numerous observations by engineers.

The first well recognised fact is the destruction of the coast from the point of Barfleur as far as the Somme, a distance of 338 *kilometres*; and on the other side of the channel, from the Isle of Wight to Dover, a distance of 250 *kilometres*. This action is produced by the alternation of frost and thaw, by dry and moist winds, and by the saline evaporation of the sea. The abrasion observed on the coast of Calvados is an average of 0 *met.*, 25, *per ann.* and on the coasts of Normandy and England 0 *met.*, 30. The mean height of the cliffs on either side being sixty *metres*, it follows that the channel swallows up an amount of 10,000,000 *cubic metres* of earth and stones every year, which must find a place somewhere.

The second fact, equally well established, and which, though opposed to the opinion of the ancients, can no longer leave any doubt on the mind, is, that rivers, with a few rare exceptions,—such as the Loire for instance,—only carry to the sea an extremely thin mud, destined to be lost in the mass of matter held in suspension by the latter; that the sands of rivers do not in general reach the sea, and that the muddy or sandy deposits observed in tidal rivers, are entirely owing to the matters brought by the tide. This discovery has been arrived at as follows.

In making the analysis of the alluvial lands forming the Bay of St. Michael, it was found that the principal substances of their formation are silex and

the carbonate of lime; that the nearer the sea is approached, the more the proportion of silex increases; the more it is receded from, the more considerable the proportion of carbonate of lime becomes. Now if the basins of the three rivers which discharge themselves into this bay, the Sée, the Selime and the Couësnon, be examined, they will be found entirely destitute of calcareous substances. It is the same with the coasts of the channel and of Brittany. It cannot, therefore, be either from these rivers or from the coasts that the enormous proportion of silex proceeds which has just been described. If samples are examined with a magnifying glass, commencing with those nearest the sea, and afterwards proceeding farther into the bay, in the first, fragments of shells are perceived quite distinguishable, then these fragments are reduced and become so impalpable, that the best glass will no longer enable us to distinguish the form in the most calcareous portions.

It is, therefore, certain that the calcareous part comes exclusively from the sea, and even from the bottom of the roadstead of Cancale. As for the silex and clay, a part in their deposit may be attributed to the rivers; but it should first be understood how unimportant these three small rivers are, each discharging not more than an average of eight to ten *cubic metres* of water per second. Farther, if the contributions of the rivers reckoned for anything in the deposits which are made in this locality, clayey or gravelly stratifications would be seen on their banks at the parts where the tide is least felt. Nothing of the kind occurs. The mixture of the calcareous matter, the grains of silex,

and the argillaceous atoms is so intimate, that it is evident it could only be made at the very centre of the production of the calcareous matter ; that is to say, at the bottom of the sea. If the fluviatile deposit was appreciable, it would counterbalance entirely, or in part, the calcareous overplus in the drift taken from the top of the roadstead, as compared with that taken at the bottom. Far from this being the case, the progression of the calcareous element, which can only come from the sea, is seen in proportion to the elevation of the shores. Finally, if the fluviatile deposit ought to be reckoned for anything, a larger proportion of clay would be seen upon the brink of the Sée, which traverses fissile lands, than in the neighbouring channel of the Couësnon, which traverses lands of a much harder character, furnishing less clay than the fissile ground of the Sée and the Selime. Now, the contrary is the case ; the drifts of the neighbouring channel of the Couësnon are more clayey than the others, solely because this channel being more sheltered than the beds of the other two rivers, the muddy matter which the sea always holds so abundantly in suspension, and which it deposits in the basins of ports, can be carried there concurrently with the drifts.

On making the same investigations for the Seine, it was found that the sands transported by this river do not pass Rouen, and that all the accretions that are seen lower down, as far as the flats which are met with at its mouth, are deposits by the sea.

The same results were arrived at for the Scheld.

As to the Meuse and the Rhine, the following deductions have been made.

The abrasion of the coasts of the channel supplies the sea with fragments of chalk and siliceous rocks, which being rolled about by the sea become shingle. This shingle forms banks along the English and French coasts, and forced by the double action of flood and wind towards the straits it approaches them; but the shingle on the coast of France continually decreasing in size, reaches the mouth of the Somme, where it finds the point of Cayeux formed by its accumulation. Stopped at this point by the waters of the Somme, and by the change in the direction of the current of the sea which turns towards the Pas de Calais, this shingle increases the point of Cayeux, so long as its continual collision has not sufficiently reduced the size of the stones for them to be carried away by the sea; but when they are small enough, the flood bears them away and distributes them on the numerous banks which are found between the Somme and the Pas de Calais. From the inspection of Marine Charts, it is seen that the fineness of the deposit increases in proportion as these banks are nearer to the straits, and if the banks disappear in the Straits, it is because the force of the current does not allow the sands, which from being sifted for a long time have become finer and finer, to stop in that passage. They pass it therefore and some go to form the downs between Dunkirk and the Scheld, others in like manner to form downs on the English coast, others remaining in the strongest currents are carried as far as the mouths of the Humber in England, and of the Meuse and Rhine on the Continent.

If the shape of the English and French coasts to the north and south of the Straits is observed atten-

tively, it will strike every one that those to the south are cut out into concave indentations, while those to the north all affect the convex form. It is because the coasts to the south of the Straits are abraded by the tide, and those to the north, on the contrary, are fed by the accretions. As for the muddy matters in this long course, they can only be deposited in a few perfectly tranquil creeks, or in the basins of open ports on either coast. Wherever the tide penetrates they are carried with it, and, when finally it has entered the northern sea, and made a course sufficiently long to abate its swiftness, it finds itself in an excellent condition for depositing these muddy matters, which it holds in suspension. This is what it does at the mouth of the Humber, where it completely chokes up the port of Hull.

In like manner, the muddy matters form at the mouth of the Rhine, of the Meuse, and of the Scheld, those immense polders, which constitute such an essential part of the territory of Holland, and the numerous banks at the mouth of these rivers are only composed of sand and carbonate of lime. Now the rapidity of the current, long before reaching the mouth, is not sufficiently great to carry down the sands; in fact, no trace of them is perceived; these banks are therefore the production of the sea.

Finally, in order to appreciate at the *maximum* the power of the fluvial deposit in the formation of the coasts, observations have been made upon the Yssel, that branch of the Rhine which discharges itself into the Zuyderzee. This sea has but very feeble tides, 0 *met.*, 40, at ordinary high water, and

very much resembles the Mediterranean, the Black Sea, and the Adriatic Gulf in this respect. A muddy Delta has also been formed at the mouth of the Yssel, of the same shape as those of the Rhone, the Po, the Nile, &c. &c. This Delta cannot be exclusively owing to the Yssel, because, although it is true that the tides of the Zuyderzee are very feeble, on the other hand the shores which surround it are of an exceedingly friable nature; now, however feeble the tides may be, they yet attack the banks, and what proves it, is, that the Hollanders are obliged to defend them. By considering the Delta of the Yssel as a fluvatile deposit solely, we shall therefore have an extreme case. Now, this Delta has a superface of only 1500 *hectares*, while the superface of the land in Holland, which is evidently of modern deposit, is at least 1,000,000 *hectares*. If it is observed that the Yssel only emits a fifteenth of the whole volume of the Rhine and the Meuse united, it will give 22,500 *hectares* for the deposit of the river, against 1,000,000 deposited by the sea; which is scarcely two per cent. of what the sea has furnished in the formation of the polders of Holland.

From the examination of all these facts, it evidently results, as we have said, that in seas with tides, the rivers not only do not form banks, alluvium, or deltas at their mouths, but farther, that the alluvium found in the regions of these rivers submitted to the action of the tide, is deposited by the sea.

We shall now prove that these conclusions are equally true for the rivers of the Mediterranean, notwithstanding the opinion of the Italian engineers,

who have considered the fluviate origin of their deltas as demonstrated.

To give an idea of the propagation of the waves or billows of the sea agitated by the wind, they have been compared to a field of corn under the action of the air. It seems as if the ears of corn had an impulsive swiftness, which however does not exist, since they do not quit their places. Farther, if the wind is feeble, it is only the ears which waver without the stalks being shaken ; but, in proportion as the wind rises, the stalks take part in the movement to a greater and greater depth down to the root.

The waves have been again compared to the movements of a cord, which is made to undulate by shaking one of its extremities in the hand. It seems as if the cord was going at a rapid rate, while in reality it does not quit the hand that shakes it, only each point of it rises and falls alternately, and this movement is the greater according as the impulse is stronger ; if the extremity of the cord opposite to that which receives this impulse encounters an obstacle, as the surface of a wall for instance, it will strike it at each movement of the hand.

It is exactly the same with the waves of the sea ; every fluid molecule placed at the surface of the billow experiences an oscillatory movement nearly vertical, so that if a body floating on the surface of a wave is watched it will be seen to remain in the same place, sometimes in the hollow of the wave, sometimes on its summit, and if at length it changes its place, that depends upon other circumstances, such as the force of the wind or the direction of the currents.

This oscillatory movement which is perceived on the surface of the sea, is necessarily developed to a certain depth, which will be greater in proportion as the undulations are stronger at the surface. This fact has been confirmed by experiment; it has been ascertained in effect that the agitation of the sea caused by the wind, is communicated to a certain depth, variable according to the wind, according to the sea, and the places where the observations were made, and that beyond that depth the sea is perfectly calm. Thus it may be admitted as an observed and well proved fact, that the waves require a certain depth for their free developement; if an obstacle is presented to this developement, there will be a forcible re-action of the wave against this obstacle which will be carried off, if it is moveable, and will enter into the system of the wave. This action of the waves against the deeps is what is called the *ground swell*.

This established, it has already been seen that the coast of the sea, as well as the projecting capes, resign to the sea every year a certain amount of earthy and rocky matters. These matters are removed by the waves which break upon the shore, the soft portions are quickly disintegrated by this powerful action, and form muddy sand and mud, and the hard portions are rounded into pebbles the size of which is diminished more and more by the prolonged action of the force which set them in motion and which reduces them to sand; but in proportion as these matters arrive at a sufficient degree of tenuity, they become susceptible of submitting to the transporting force of the waves and currents, and quit the place where they were formed.

This transporting force depends both upon the height of the tides and the direction of the winds, as well as their intensity, combined with that of the currents which are observed in all seas. So that while considerable masses of matter are set in motion along the shores, the rivers, especially those which traverse a great extent of country, transport as far as their mouths only muddy matters, so light that they are carried to a distance, and afterwards deposited in the depths of the sea. This is remarkably the case with the Nile, whose waters at the time of the inundation are distinguished by their colour for more than ten leagues into the sea. All the deposits and accretions of the river up to 20 *kilom.* above its mouth are muddy, while all the banks which are at its mouth are composed of sand alone.

Thus, all the impediments of the mouth of the Nile evidently emanate from the sea. To demonstrate it by still farther evidence, we will repeat the reasoning of the engineer M. Bonniceau relative to the alluvium of the river Mersey, in his excellent work upon the navigation of tidal rivers: “ If the
 “ deposits emanated from the elevated lands in a sensible degree, the quantities deposited from time
 “ to time ought to be proportional to the quantity
 “ of rain that falls at the same epochs, because the
 “ same amount of matters descending from the elevated lands and transported by the river, ought to
 “ be partly regulated by the quantity of water that
 “ carries them ; but it is a fact well ascertained, that
 “ the accumulations of sand which exist in the vicinity of the mouth are greater in proportion as the
 “ waters of the river are less abundant, while on the

“ contrary at the time of the increase, when the Nile
 “ contains nearly 0 *met.* 008 of matter in suspension,
 “ the sand banks are removed and thrown back far
 “ off into the sea.”

It is said that Alexander the Great was determined in his choice of the situation for the port of Alexandria by the consideration of the winds and littoral currents which carry eastward the matters held in suspension by the Nile, and thus cover the coast with sand. If this theory were true, no alluvium ought to be perceived westward of the mouth of the river. Now all the coast from Tripoli as far as El Aritch is covered with sand banks, which frequently form downs, and these downs are found at the present time transported several leagues into the interior of the lands westward of the Rosetta mouth.

The port of Alexandria itself has not escaped the action of the ground swell, for a sand bank has been formed which occupies a good third of the total superface of the roadstead. Happily for the port the accumulation of sand appears to have been arrested long ago, or rather its increase has become imperceptible.

The roadstead of Alexandria owes its depth to the disposition of its sides in respect to the winds and currents. It is like the roadstead of Algiers, which is everywhere very deep, while the neighbouring ports have sand banks. It cannot be said that these sand banks are owing to the presence of rivers, which do not exist in the whole extent of the coast of Barbary, for the few land streams that are scattered along the shore cannot be called by that name.

We have seen that the winds and the currents carry

the detritus of the coasts reduced to sand to great distances. The currents however do not arrest the motion of the waves and the ground swell; they bend to their forms, and as their direction necessarily tends to the shore, the sands clear the currents with the ground swell which contains them, and which thus conducts them to the shore. When the direction of the waves is oblique to the coast, the sands are borne to a distance, but when it is perpendicular to the coast, the waves raise the sands brought by the ground swell into dykes and banks, which protect the low shores. The most minute and lightest portions are accumulated at the more elevated points of the flats, where, being dried by the sun, they are soon carried away by the wind, which leaves them, in its turn, in the shape of downs. The ground swell, therefore, furnishes the materials of those downs, which usually border flat shores, and it is that which has drawn from the depths of the sea the sands of those immense deserts of Africa, and of so many other plains which are found in various parts of the globe.

“Often,” says M. Jomard, “have I remained
 “for whole hours, contemplating the origin and
 “progress of the phenomenon of the formation of
 “sands. I saw the waves break and deposit a small
 “line, scarcely discernible, of very fine sand. An-
 “other wave came, burdened like the first, and this
 “new line of sand pushed the first slightly on.
 “This, once beyond the reach of the water, and ex-
 “posed to the rays of a burning sun, was quickly
 “dried, and became the prey of the wind, which
 “immediately seized and carried it off into the air;

“ the less light particles of gravel did not reach so far, but, subjected to the alternate motion, diminished more and more, and were converted by degrees into sand.”

We may also say with Colonel Emy, that

“ All river bars are deposits, brought or arrested by the ground swell, and without it these deposits would be repelled into the main as far as the rivers extend their course. The Delta of the Nile, those of the Mississippi, of the Ganges, of the Scheld, of the Meuse, of the Rhine, and the Camargue of the Rhone, were originally bars formed by this same ground swell.”

The tongues of sand which separate the lake of Thau from the gulf of the Lion, the tongue of earth upon which Alexandria is built, those which separate the lakes Bourlos and Menzaleh from the Mediterranean, are bars of sand formed by the ground swell. The sand bank which separates from the Red Sea the vast basin of the Bitter Lakes, was, without any doubt, a ford elevated by the ground swell, which, in tempestuous weather, ascends this sea with the current of the tides charged with sand. The ford, which answers at the present time at Suez, was certainly formed in this manner by the ground swell.

We may say also, that the whole Isthmus of Suez was formed by the maritime deposits of the Mediterranean and of the Red Sea. We believe that, previous to historic times, the two Seas were in communication with each other, that the detritus of the chains of mountains situated to the right and left, carried down by rain, filled up the space which se-

parates them, and that when that space was elevated to such a height that the ground swell could reach it, its action was applied in such a way that by the meeting of the swell of the two Seas, a bank was formed, which is no other than the bar of El Guisr. After the formation of this bank, the combined action of the ground swell, both on one side and the other, and the accretions from the neighbouring mountains continued until the Isthmus was dry. Then the soil thus constituted was covered by the downs, which advanced upon it from the direction of Pelusium, driven by the north winds, and from the direction of Suez, driven by the winds and currents from the south.

In this state the Isthmus is at present, and the numerous soundings which we have asked for from His Highness the Viceroy, will prove whether our hypothesis is well founded or not.

The same theory may, as Colonel Emy observes in his remarkable work, throw a new light on important geological facts :—

“ For instance, those ancient and elevated plains,
 “ composed of sand and pebbles, the formation of
 “ which, it has been attempted to explain, by the
 “ revolutions of the globe and violent convulsions
 “ of nature, or which have been regarded as deposits
 “ left by rivers, appear to be maritime accretions.
 “ It is, indeed, easy to conceive rivers capable of
 “ bringing down the fragments detached from
 “ mountains, by shocks, and by the decomposition
 “ of the rocks ; but how could they extend those
 “ fragments uniformly, and over spaces so extensive
 “ as the plains in question ? Moreover, was not the

“ course from the summits of the mountains gene-
 “ rally too short for the fragments of the excessively
 “ hard rock found in some of those plains, to have
 “ time to acquire their roundness? The rivers have
 “ prolonged their courses through these accumu-
 “ lations of pebbles; they may, in overflowing, have
 “ covered them with sand and earth, but it is more
 “ probable that they contributed in nowise to the
 “ formation of these accretions, unless it were by
 “ transporting the rough materials to the sea. No-
 “ thing but the ground swell could spread these
 “ fragments of mountains so uniformly as they are,
 “ convert them into shingle and sand by a long
 “ trituration on the shores, where it had driven
 “ them; gather them either into banks or plains,
 “ and thus fill up spaces over which the sea formerly
 “ extended.

“ The ancient collections of shingle, pebbles and
 “ sand are owing, like those at present forming
 “ in a similar manner, to maritime accretions, and
 “ must henceforth be regarded as an incontestable
 “ proof that the ocean formerly reached and was
 “ long stationary at different heights far exceeding
 “ its present level.”

It is not surprising, then, to find on divers points
 of the Isthmus pieces of hard stone broken into
 small fragments, and half rounded, covering the
 sand-banks at variable heights above the level of the
 Mediterranean.

But, be it as it may, it is certain that throughout
 the length of the line, from the roadstead of Suez to
 that of Pelusium, the excavations will only be in
 light earth, which can be easily removed by hand

as far as the water line, and with dredges down to the bed of the Canal.

The track which we have followed for the Canal was prescribed by the very nature of the locality, and by the condition that the two Seas were to be brought into direct communication in the most economical manner.

The line begins at the roadstead of Suez, turns to the east of the town, making a curve to reach the ancient track, which it leaves to the west, and follows the channel of the valley until it joins the Bitter Lakes, which anciently formed the extremity of the gulf of the Red Sea. It traverses those lakes throughout their length, following their sinuosities, so as to avoid the inequalities of the ground. On leaving the lakes, the line crosses the bar of the Serapeum, at its lowest point, and enters Lake Tim-sah, leaving the heights of Cheik Ennedek to the east.

The last-mentioned lake is to serve in the formation of an inland port, in which ships may be re-victualled and repaired, while it will be the point of junction between the Maritime Canal and the Canal communicating with the Nile.

In traversing this lake, the line forms several curves, in order to avoid the extensive downs which have encroached upon a part of that region.

On leaving the lake, the line proceeds to the bar of El Guisr, at its lowest point, and then goes towards Lake Menzaleh, which it follows directly along its eastern shore as far as Pelusium, and is prolonged into the sea until it reaches a depth of 7 *m.*, 50.

The dimensions of the Canal have been determined by the idea of creating a grand passage for maritime navigation, open to steam and sailing vessels of considerable burthen. The Caledonian Canal is the only known analogous work. This Canal, however, is but 37 *m.* broad at the water line, and but 6 *m.*, 10 deep. The locks, to the number of 23, have been enlarged so as to admit forty-four gun frigates; they are 52 *m.*, 40 in length between the gates, 13 *met.* in breadth, and have a depth of water of 6 *m.*, 10.

For cutting through the Isthmus of Panama by a maritime canal, as projected by Mr. Garella, it was proposed that the width of the canal, at the water line, should be 44 *met.*, and the depth of water 7 *met.*

Prince Louis Napoleon, who, in 1846, published a remarkable work, inserted in the *Revue Britannique*, under the title of *Canal de Nicaragua*, adopted the same dimensions as Mr. Garella, in the project which he proposed to execute for establishing the communication between the Atlantic and Pacific Oceans.

We have assumed on considerations hereinafter to be explained, that paddle and screw frigates as well as vessels of 1000 to 1500 tons, ought to be able to traverse the Canal in order to satisfy to the fullest extent the demands of navigation. We have therefore fixed the width of the Canal at the water line at 100 *met.*; its *minimum* draught of water at 6 *m.*, 50, below low water in the Mediterranean. The locks, two in number, are to be 100 *met.* long, 21 *met.* wide, with a *minimum* depth of water of 6 *m.*, 50. These works will be established at the two extremi-

ties of the Canal, immediately before the dykes forming the channel which on each side unites the Canal with the two Seas. These two locks will form part of a sluiced barrage, and thus convert the whole Canal into one immense dam, receiving the waters of the Red Sea during the highest tides, and storing them up successively in order to raise the level and create a rush of water in each channel when necessary. The highest tides of the Red Sea being from 2 *met.* to 2 *m.*, 50 above low water in the Mediterranean, a depth of 9 *met.* of water will be obtained in the canal at certain times, but a mean super elevation of 1 *m.* may be depended on, which will usually give a minimum depth of 7 *m.*, 50 to 8 *met.* Under these conditions, screw steamers will be enabled to pass easily along the Canal without the presence of its bed re-acting in an inconvenient manner on the motion of their screws. We have, however, calculated the earth-works for three different depths of water, viz. 6 *met.*; 6 *m.*, 50; and 7 *met.* below low water in the Mediterranean. If the Company should require a depth of 8 *met.*, it would be easy to obtain it by means of dredges, without stopping the navigation on the Canal.

The length of each barrage, including the lock, is 100 *met.*; and in order farther to facilitate the entrance of the rising tide into the Canal, a third barrage has been added at Suez on the site of the existing channel. This last work will be separated from the first by a platform raised above the level of high water, so that the two together will unite the road from Cairo passing by Suez to Mecca. Its length has also been fixed at 100 *met.*

For reasons of economy the width of the Canal has been reduced to 65 *met.* wherever the height of the ground reaches 6 *met.*

To prevent the degradation of the banks of the Canal, the slope has been fixed at two on the base to one in height, and it is proposed to have a causeway 2 *met.* broad to receive, 1st. A covering of the broken stones found along the Canal, 2nd. Any earth falling from the higher grounds, which would otherwise encumber the bed of the Canal. This is only an imitation of what has proved so successful on the Caledonian Canal.

The width of the towing path has been fixed at 4 *met.*, which is quite sufficient for a maritime canal where steam towing will be so much in use.

Lake Timsah, situated nearly midway between the two Seas, at the entrance of the *Wady Tomilat*, will form, as we have said, an inland port, to which both the outward and inward navigation will tend. On its shores will be established magazines, stables, workshops for repairs, as well as 1500 *metres* of quay walls for mooring vessels and embarking merchandize. For, as the illustrious author of the work on the canal of Nicaragua well expresses it, the proposed Canal must not be a mere cutting destined solely to form a passage from one sea to the other for the produce of Europe, but it must make Egypt a prosperous state by enabling her to dispose of her interior produce, and a powerful one by the extent of her commerce.

As for the two entrances, whether from the Red Sea or the Mediterranean, all that is necessary is, that ships shall be able to approach at all seasons, and

find certain and effectual shelter in bad weather. Now the roadstead of Suez is sheltered from every wind except the south-east. It will therefore be sufficient to prolong the eastern jetty to a certain distance beyond the western to render the shelter complete.

All the vessels which now take their stations in the roadstead ride out the bad weather very well, and the magazine corvette belonging to the English Company which has been anchored there for the last two years and a half has suffered no damage.

Thus, at the Suez extremity, it will be sufficient to establish two jetties, forming the entrance channel from the Red Sea, and to prolong them sufficiently far into the roadstead to reach the required depth of water, in order that vessels entering may have a draught of 7 *m.*, 50 to 8 *met.* at low water. The eastern jetty must be 150 *met.* longer than the western for the reasons we have just given.

At Pelusium, the two jetties, in order to reach the depth of 7 *m.*, 50 to 8 *met.* must be at least 6000 *met.* in length; but if it should be feared that the channel thus formed would not be sufficiently safe for the approach of vessels, and in order to meet objections, the real value of which have yet to be tested, we have projected a sheltered roadstead in front of these jetties by means of a grand mole from 450 to 500 *met.* in length, placed in such a manner as to afford shelter to vessels in bad weather, and to enable them to enter the channel at their convenience.

At all events no one can doubt that the Canal would be really and practically navigable for all vessels willing to avail themselves of the passage.

But it will be asked whether jetties extending 6000 *met.* into the sea do not present great difficulties ; whether a trench of 65 *met.* in width, dug 16 *m.*, 50 deep, a part of which is under water, is not an impossibility ; and whether, supposing the engineering difficulties to be surmounted, the results obtained would be in proportion to the expenses incurred. Doubts have also been started on the navigation of the Red Sea ; finally, several authors have put the question, without however solving it, whether, even if the Canal were once established, commerce would not prefer the old way by the Cape as the safest and most advantageous.

These questions we are about to examine : these doubts we shall endeavour to clear up.

The Gulf of Pelusium is said to be constantly filled with sand or mud brought down by the Damietta branch of the Nile, and it is objected that the advanced works to be established on that part of the shore would only have the effect of increasing the accumulations. We admit that this portion of the Egyptian shore has been formed by maritime alluvium brought by the ground swell, as we have already proved at the commencement of our memorial. We also admit, that the object of the dykes forming the entrance channel to the Canal, would be to stop the sand thus brought by the waves, and to accumulate it against the dyke opposed to the prevailing wind, namely, against the western dyke.

But most of the ports already in existence are open to the same objections ; and if they were sufficient to prevent the construction of a port, we may safely say that very few of those we are at present acquainted with would ever have been formed.

According to our idea the essential question is, to know whether, when once the port is established, it can be maintained without too great an expense.

Now it appears, that for many ages the sands have ceased to extend the Pelusiatic shore, as is manifest from the well ascertained position of Pelusium, the ruins of which still remain. Strabo, in his Itinerary, says that Pelusium is situated at the distance of twenty stadia from the sea. The French engineers of the expedition have verified this distance, by measuring 1600 toises, or 3000 *met.* from its remains to the shore.

In 1847, the distance between these two points had not varied, as it is marked on the plan with the figure 3000 *met.*, and at the present day it is still the same.

In fact, by reading all the accounts of ancient authors, and comparing them with what actually exists, we arrive at the conclusion that the shores of the Delta have varied very little in historic times.

The sea sands then have long ceased to accumulate, and the fact may be explained by assuming that the destruction of the coasts of Morocco, Algeria, Candia, and other parts,—which destruction, we repeat, alone furnishes the materials of maritime alluvium,—has abated from some cause or other. It may also be assumed, that the sands which were formerly driven by winds and currents into the Gulf of Pelusium, are now cast on the African coast between Tripoli and Alexandria, and driven inland in the shape of downs. The fact is, that no new downs are now seen forming in the Isthmus; those on the seashore being of ancient formation, and nearly all naturally fixed by vegetation. In conclusion, the

extension of the Pelusiac shore, if such extension there be, is too insignificant to be taken into consideration.

Now, the direction of the jetties being nearly perpendicular to the shore, in order to be at right angles with the prevailing wind from W. N. W., the sand, when the wind is perpendicular to the shore, will be driven on to the coast and increase its height, as hitherto, no change being occasioned by the jetties. During the parallel winds, which mostly prevail, the littoral current, finding an obstacle in the jetties, will form an eddy to windward, which will increase the force of the current between the points of the jetties and the mole, so that the sand will be carried far away; and the probability is, that the bottom will become deeper.

It is only the oblique winds then, that will carry the sand into the angles formed by the shore and the windward jetty.

In calm weather, the sea-current which flows along the coast from west to east has not sufficient force to affect the equilibrium of the beach. Thus, to sum the matter up, the most that can be feared is the accumulation of a small quantity of the loose sand in the Gulf at the angle of the windward jetty. Supposing that even 10,000 *cubic metres per ann.* should be so deposited, which, according to what we have said, is an exaggeration, it would take 100 years to advance the beach 400 *metres*, and such an advance would produce no perceptible effect at the extremities of the jetties.

It may be objected, that by all these movements of the sands, some portion will necessarily find its

way into the channel, and thus, by degrees, end in obstructing it. To obviate this inconvenience we have at our disposal dredging machines, and the most powerful means of clearance derived from a mass of 700,000,000 *cubic metres* of water, which can be stored up, above the level of low water in the two Seas, throughout the whole extent of the Canal, and in the immense reservoir of the Bitter Lakes.

But are jetties extending 6000 *metres* into the sea possible? and if possible, would they not require so much time and such an expenditure of money as, practically, to cause the undertaking to be given up?

With regard to the possibility, there can be no doubt, for more than a century ago the Dutch Government constructed a jetty 8000 *met.* in length in the Bay of the Lion, near the Cape, in water more than sixteen *met.* deep, in spite of the continued tempestuous weather which succeeds the settled calms in those latitudes. Such a work, considering the depth of water, must have required a quantity of materials at least four times as great as that required for the two jetties and the mole at Pelusium. It was undertaken by a nation not over rich, at a time when steam was unknown, and before the invention of machinery, which saves so much time, expense and labour. There can be no doubt then, that if the cutting of the Isthmus is admitted to be advantageous, it will be easy to overcome all difficulties.

With regard to the method of constructing these works, opinions are no less divided. Some engineers, grounding their opinions on ancient constructions, recommend that the moles should be formed of im-

mense blocks of stone of thirty to forty *cubic metres*. Others are of opinion that the only means of preserving the roads from the accumulation of sand, is to construct the moles and dykes of open masonry. There are also some in favour of walls in hydraulic masonry with vertical facings. But, our own opinion is, that in so important an enterprise, every theoretical hypothesis should be discarded, and that we ought to be guided solely by the experience we have acquired in works of an analogous character already executed. And this is what we have done in adopting the system of loose stones, as it has been carried out with success :

1. For the dyke at Cherbourg which is 3768 *met.* long in a depth of water of 14 *m.*, 80 ;
2. For the jetty at Plymouth which is 1364 *met.* long in a depth of 11 *met.* and more ;
3. For the dyke in the Bay of Delaware 1200 *met.* long, with a depth of 14 *met.* ;
4. For that of the Bay of the Lion 8000 *met.* long, in depths of more than 16 *met.*

Objections to this system may, indeed, be raised on account of the damage sustained at Cherbourg and Plymouth as well as at Algiers, before the introduction of factitious blocks, but it is necessary to observe, that both at Cherbourg and Plymouth, the tidal current is exceedingly strong, its velocity being as much as 4 *met.* per second ; that the sea at these points is very rough, and that there is reason to suppose that the damage would not have occurred had the blocks been rather larger, and the interstices well filled up. With regard to the roadstead at Algiers, it is, as is well known, constantly beaten over by heavy seas, no other point in the Mediterranean presenting such difficult conditions. We have in

favour of our system most of the moles erected in the various ports of the Mediterranean, Genoa, Cannes, Barcelona, Valencia, Cadiz, &c. &c., all of which are constructed of natural blocks, the largest not exceeding 2 *m.*, 50 cube, and which are nevertheless established at considerable depths of water. Finally, we have on our side the opinions of the most distinguished English engineers; opinions which have prevailed in Parliament, and in accordance with which, all the moles in the harbours of refuge in course of construction are being made, according to the system of natural blocks sunk into the sea, at certain slopes.

The bottom of the beach, descending by a very gentle inclination, will, moreover, have the effect of abating the waves, and diminishing their action against the jetties. This is a well ascertained fact, and one which may, indeed, be easily conceived; for, supposing that the bottom of the sea, from a depth below the limit of the motion of the waves, rises by an extremely gentle slope, until it meets that limit; this meeting taking place at a very small angle, the bottom will be almost insensibly substituted for the limit of motion.

At the point of this meeting the undulating motion is *nil*, it is very feeble at the adjacent points, and easily abated by the resistance and friction which the molecules experience against the bottom. The abatement will thus extend vertically up to the surface, and the waves will then gradually diminish in volume as they approach the shore.

We have, therefore, adopted the system of loose stones for the jetties and for the mole, with but

slight modifications suggested by our own experience, modifications which consist in making the jetty-heads in hydraulic masonry to a certain height, as well as the interior surface of the windward jetty, which is to serve for the towing of vessels.

What we have said of the gulf of Pelusium we may repeat, still more forcibly, with regard to the roadstead of Suez. The sands have long ceased to accumulate in any perceptible manner. And if maritime alluvium is still brought up by the ground swell and the current, it is driven by the west and south-west winds on to the eastern shore, without reaching the extremity of the gulf. In fact, the plan of the roadstead was taken in 1799, and the soundings of the channel are marked, as well as the shape of the sandbank, which forms a kind of bar at its extremity towards the roadstead. In 1847, the plan was taken again with the same soundings, and it is impossible to find the least difference between the two results, which also agree with those given by Commander Moresby, in his excellent chart of the Red Sea.

There is, then, nothing to fear on that side, either from the sand or the violence of the sea. The jetties will be of the simplest construction, and as the materials are, as it were, at hand, their erection will present no difficulty.

With regard to the excavation of the Canal to a depth of 6 *m.*, 50 below low water in the Mediterranean, in a very porous soil, the task, at first sight, presents what appear to be considerable difficulties. We cannot, indeed, hope to accomplish the whole of the excavation in the dry, or by pumping, on ac-

count of the nature of the ground. It will be necessary, then, for all that portion below water, to have recourse to dredging; and, as the quantity of earth to be removed by this means is 57,205,342 *cubic metres*, at first sight it is difficult to conceive how the work is to be accomplished. But, upon examining the matter more closely, nothing is found to frighten the most timorous. In fact, a single steam dredging machine, of twenty horse power, such as those which have been employed on the Nile, working night and day, can, in twenty-four hours, raise 1000 *cubic metres* of sand, from a depth of seven *metres*. According to this calculation, and supposing the year to consist of only 270 working days, it would take forty dredging machines five years to complete the labour; but if, instead of such small machines, dredges of thirty to thirty-five horse power were adopted, it would be easy to raise 1500 *cubic metres per diem*, and the dredging would be more economical.

The quantity of earth to be raised by manual labour amounts to 17,473,790 *cubic metres*, and the deepest cutting does not exceed 10 *metres* above the water. This is a small matter when compared with the earth-works performed in many canal and railway undertakings, and even with those accomplished before the present century; such, for example, as the one mentioned by Michel Chevalier, in his investigations concerning the maritime canal of the Isthmus of Panama (*Recherches sur la Canalisation maritime de l'Isthme de Panama*).

"It required," says he, "the treasure which the Viceroy of Mexico had at their disposal to under-

“ take the cutting at Huehuetoca, the total length
 “ of which is 29,585 *met.*, with a depth of from
 “ 45 to 60 *met.*, for a length of 800 *met.*, and from
 “ 30 to 50 *met.* for 3500 *met.* The expense was
 “ 31,000,000.”

Farther on, he adds :—

“ Nowadays, however, in a case of necessity, by
 “ displaying the improved appliances at the com-
 “ mand of engineering art, it would be possible to
 “ effect cuttings of great depth, and to remove large
 “ quantities of earth at no extraordinary expense.
 “ On the Arles canal, at Bouc, for instance, the
 “ plateau of the Lecque was cut through by a trench
 “ 2100 *met.* in length, by 40 to 50 *met.* in depth,
 “ at the culminating point. The expense was under
 “ 4,000,000, and yet the cutting was performed by
 “ the old method. In cuttings of magnitude, the
 “ soil is now broken by instruments of enormous
 “ power, and the earth is removed by means of rail-
 “ ways and locomotives. All that has to be done
 “ by manual labour is to collect the loose earth and
 “ load the waggons. For so important an object as
 “ the uniting of two seas, even the impossible might
 “ be attempted.”

Supposing each labourer to do 1 *m.*, 50, on an average, *per diem*, it would only require 8000 labourers for five years to complete the earth-works ; and not a year passes without a levy of between 30 and 40,000 men being commanded by the Viceroy, in several provinces at once, for the service of the canals alone.

As soon as the project of a ship canal across the Isthmus of Suez is ascertained to be useful and ad-

vantageous, no difficulties of execution, however great they may be (and we have proved them trifling), will be considered obstacles to its being carried out.

It would appear at first sight superfluous to demonstrate the utility of such an undertaking, for what especially strikes the imagination, is the magnitude of the results promised by the Canal, and the reiterated efforts made at several epochs, even in times of ignorance, to open this communication between the two Seas.

But since the publication of M. Lepère's memorial, so many objections have been brought forward and so many doubts raised, that public opinion is undecided, and it becomes necessary to re-establish the question in all its integrity. We will therefore examine the principal objections raised against the direct communication between the two Seas.

It has been said that the navigation of the Red Sea is so dangerous, and that the monsoons cause such delays, that even if the Canal were established and freely traversed by ships, commerce would not follow that route, which would in fact, from these peculiar circumstances, be the longest and most perilous.

In the first place, there can be no question here about steam navigation, the circle of which extends daily more and more, for the projected Canal will be the triumph of steam ; it will greatly increase the use of the screw, and give a new stimulus to British navigation, which will be charged with the delivery of English coal throughout the whole line from London to Australia. We will therefore only examine the case of navigation by sailing vessels. Now, we learn from history, that from the most distant ages, this

navigation has flourished in the Red Sea, and that after the discovery of the Cape of Good Hope (in 1497), the Portuguese considered it necessary to have a fleet, which, in 1538, destroyed all the merchant vessels of the Turks and Venetians. If in later times commerce took the way of the Cape, we have only to thank the Turkish sovereignty of the period, which allowed the arts, sciences, and industry to perish, at the same time that it forbade the navigation of the Red Sea to the European nations. How can this navigation be considered full of danger at the present day, when nautical science and the art of ship-building have made such great progress, and when everything relating to the winds, the currents, and the coasts of the Red Sea, is perfectly well known?

To leave no doubt on the subject, we will repeat the most important observations which have been made on the Red Sea and Indian Ocean.

This is what the English traveller, Bruce, says in 1769 :—

“ Those who are at all acquainted with the history
 “ of Egypt, are aware that the north wind, there
 “ called the Etesian wind, prevails during the six
 “ hottest months of the year. The two chains of
 “ mountains, which confine Egypt to the east and
 “ west, compel this wind to follow precisely this north-
 “ erly direction. It is reasonable to suppose that it
 “ would be the same for the Arabian Gulf, if the course
 “ of that narrow sea were parallel to the land of Egypt.
 “ But the Red Sea extends nearly from north-west to
 “ south-east, from Suez to Mocha ; there it alters its
 “ course, and proceeds nearly from east to west, as far

“ as its junction with the Indian Ocean at the straits
 “ of Bab-el-Mandeb.

“ Thus the Etesian wind, which is due north in
 “ Egypt, follows the course of the gulf, and blows with
 “ force in that direction all the summer ; that is to
 “ say, that from the month of April till the month
 “ of October, the north-east wind prevails over the
 “ whole extent of the Red Sea, descending as far as
 “ the straits ; and that from November to March,
 “ the wind has quite a contrary direction, and as-
 “ cends the gulf from the straits of Bab-el-Mandeb,
 “ up to the Isthmus of Suez.

“ It is observed, then, that a vessel starting from
 “ Suez, in any of the summer months encounters a
 “ very violent north-west wind, which will carry it
 “ direct from the gulf to Mocha. At Mocha the coast
 “ goes from east to west, as far as the straits of Bab-el-
 “ Mandeb. Thus a vessel sailing from Mocha will,
 “ in a short space of time, experience variable winds
 “ but mostly blowing from the west, and these winds
 “ will soon carry it to the straits. It therefore no
 “ longer wants the monsoon of the gulf, which blew
 “ from the north ; and when it has passed into the
 “ Indian Ocean, it meets with another monsoon blow-
 “ ing in an opposite direction, during the six sum-
 “ mer months, to the one which had favoured its
 “ progress in the Red Sea. This monsoon is no less
 “ favourable ; it blows from the south-west, and carries
 “ the ship full sail, without delay or obstacle, into
 “ any required port of India.

“ Returning, the same advantages may be secured
 “ by setting sail during the winter months with the
 “ monsoon peculiar to that sea, which then blows

“ from the north-east, and will carry the ship to the
 “ straits of Bab-el-Mandeb. When the straits are
 “ passed it will meet with a south-east wind in the
 “ gulf, exactly contrary to the one in the ocean,
 “ but the course of the ship is also contrary, and
 “ this south-east wind, following the direction of the
 “ gulf, will bring it to Suez. All this is clear, simple,
 “ and easily understood, and thus it is, that in the
 “ earliest ages the commerce of India was carried
 “ on without any difficulty.

“ Thus the philosophy, the observation and the
 “ indefatigable perseverance of man, who endeavours
 “ to carry out every project which his interest sug-
 “ gests, triumphing over difficulties, have taught the
 “ navigators of the Arabian Gulf, that those period-
 “ ical winds which they had, at first, regarded as
 “ insuperable obstacles to the trade of the Indian
 “ Ocean, are, when understood, the safest and the
 “ quickest means of performing the voyage.”

Mr. Rooke, an English officer, speaks in these terms, of the navigation of the Red Sea in a letter dated April 25, 1782.

“ The construction and management of the vessels
 “ are equally singular, and I fear any description
 “ will fall infinitely short of the original ; they were,
 “ I believe, designed by those who built them, to
 “ bear some resemblance to ships, but, having few
 “ of the properties of those machines, proceed on a
 “ principle totally different from any I before beheld ;
 “ that *primum mobile* to which ships of other coun-
 “ tries are indebted for their voyages is here of little
 “ use, and calms are more favourable than wind to
 “ forward their progress ; . . . they . . . seem equally

“ averse to a fair as to a contrary wind, remaining
 “ at anchor until it subsides into a calm, their busy
 “ scene then commences, the anchor is weighed and
 “ the vessel put in motion by means of the boat with
 “ about twenty oars in it, towing till a breeze springs
 “ up ; when this begins to be more than what our
 “ seamen call a light air, they hurry to the shore
 “ and let go their anchor, and for this purpose always
 “ choose a berth the most environed by rocks and
 “ shoals, never thinking themselves secure but when
 “ in the midst of danger ; their common time of
 “ anchoring was about two o’clock in the afternoon,
 “ for about that time the breeze generally freshened,
 “ and in proportion as that increases they put out
 “ anchors, till they have six in the water, and two
 “ or three hawsers besides, to tie them to the sur-
 “ rounding rocks : . . . in what they called good
 “ weather, we had not above two anchors out, and
 “ if it fell calm after sunset they ventured to get one
 “ of them up, that they might be ready for the land
 “ breeze in the morning, which generally sprung up
 “ at two o’clock and blew till nine or ten. . . . I be-
 “ lieve, without these land breezes we should never
 “ have arrived at Suez ; a circumstance that very
 “ frequently happens to many vessels of this annual
 “ fleet, for if they do not make good their passage
 “ before the latter end of May, the northerly winds
 “ blow so constantly as to render it impossible, for
 “ vessels that cannot work to windward, to get up
 “ the narrow channel from Tor to Suez.

“ When it is remembered that the journey from
 “ London to Madras has been performed in sixty-
 “ three days, it is surprising to see the English neg-

“lect so great an advantage when they have the power of securing it.”

Vice Admiral Rosily, who navigated the Red Sea in 1789, on board the frigate *Venus*, and who was consulted by M. Lepère, was far from admitting the dangers and difficulties of the Red Sea to be as great as is usually supposed. In fact, these dangers, conjured up solely by the ignorance of ancient and modern navigators, have been accredited by general opinion, or rather by general mistake. The frigate *Venus* traversed the Red Sea in all directions without experiencing either damage or difficulty. We may therefore rest assured, that no merchant vessel will encounter any difficulties but those which are inseparable from all narrow seas; the Adriatic, which is still narrower than the Red Sea, has never been considered impassable.

The coasts alone of the Red Sea are dangerous, but the number of anchorages is so great that the sailors of the country never navigate at night, but anchor every evening. In rough weather they remain at anchor sometimes for a week or a fortnight at the same place, without daring to gain the open sea or take advantage of any wind that would be favourable to an European ship.

The excellent work of Commander Moresby and Captain Rogers on the Red Sea, written by command of the East India Company, to resolve the question of its navigation, and in consequence of which the steam service of the Red Sea was established; this excellent work, we say, if it does not represent the monsoons to be as regular as is stated by Bruce, does not contradict the generality of the

facts given by that traveller, as may be judged from the following extracts :—

OF THE WINDS AND CURRENTS BETWEEN SUEZ AND
GEDDAH, BY CAPTAIN MORESBY.

“ From Suez to Geddah, during the whole course
“ of the year, the wind is generally north, and blows,
“ at times, with great violence ; but it abates usually
“ at the change of the moon. During the winter
“ months, from December to April, the south wind
“ prevails, sometimes for a few days, and occasionally
“ blows fresh, more particularly in the Sea of Suez,
“ where it sometimes attains the force of a moderate
“ gust. At this season gusts from the west are
“ not uncommon in the Sea of Suez, and are much
“ dreaded by the inhabitants in consequence of their
“ violence. On the Arabian coast, near Geddah,
“ to the south and north of that port, the north and
“ north-west winds sometimes blow with great vio-
“ lence during the winter months, and bring with
“ them clouds of dust from the land.

“ The south wind, which blows sometimes from
“ October to May, generally occasions a current of
“ twenty or thirty miles a day. After a gust from
“ the north-west, when there is a light breeze, there
“ is generally a current towards the north. It is
“ then better to beat along the Arabian side than the
“ Egyptian, as was the practice of ancient navigators,
“ who considered the latter coast more healthy.

“ The average length of the passage from Geddah
“ to Cosseir depends so much on circumstances, that
“ it is impossible to assign any fixed term for it. It

“ is, however, rarely more than twenty or less than
 “ ten days. With the boats of the country it takes
 “ from twenty-five to thirty days, and sometimes
 “ more.”

ON THE WINDS AND CURRENTS OF THE RED SEA
 THROUGHOUT THE YEAR, BY CAPT. ROGERS.

“ From the beginning of October to the end of
 “ April, during what we may call the winter months,
 “ between the straits of Bab-el-Mandeb and Gebel
 “ Tor, in about latitude $15^{\circ} 30'$ north, the wind may
 “ be said to blow continually from the south, with
 “ the exception of a day or two at the time of the
 “ new or full moon, when it sometimes blows from
 “ the north. But frequently, for two months at a
 “ time, there is no change.

“ From Gebel Tor to latitude 19° or 20° the
 “ winds are variable at the same period, and blow
 “ as much from the north as from the south. One
 “ or other of these winds respectively prevails as
 “ you approach one or the other of these limits.

“ From 21° to 27° the north wind prevails during
 “ the same season, but half a lunation seldom passes
 “ without there being one or two days of south wind,
 “ especially from the end of November to the be-
 “ ginning of March.

“ From 27° to Suez, the wind is, almost constantly,
 “ north, and seldom interrupted by any wind from
 “ the south, unless it be in the months of December,
 “ January, and February.

“ In June, July, August, and September the
 “ north wind prevails without interruption, through-

“ out the whole extent of the Red Sea, from Suez to Bab-el-Mandeb. Occasionally a change takes place, from the land side, principally in August and September, and during these months a fast sailer can make thirty-five miles a-day, beating from Mocha to Suez. In December, January, and February, a vessel will sometimes meet with a good wind from Mocha to Cosseir, and accomplish the run in six or seven days, whereas it is impossible to do the same from Cosseir to Mocha except in summer.”

It appears from these extracts that the Red Sea is easily navigable, at all seasons, by sailing vessels, and that it is always possible so to arrange the periods of departure as to traverse it in both directions.

We ought also to take into account the inconveniences experienced in the voyage round the Cape, resulting from the settled calms succeeding the continued tempests, the diseases which decimate the crews, and the disasters which are so frequent on passing the equator. We should also take into consideration that, if the difficulties are greater during a good part of the year for vessels going up the Red Sea, vessels coming down are, for that very reason, sure to meet with favourable winds.

To leave no doubt on so important a question, and on which depends, in part, the success of the enterprise in contemplation, we will give a passage from a paper communicated to the *Société de Géographie*, by Count d'Escayrac de Lauture, the motto of which is,

“ Aperire terram gentibus.”

“ If the *minimum* distances which separate the

“ ports of Europe from those of India, on the one
 “ part by the Cape of Good Hope, and on the other
 “ by the Canal of the two Seas, be compared with
 “ each other, enormous differences in favour of the
 “ latter route will be made manifest. These differ-
 “ ences become still greater, when it is recollected
 “ that, in navigation, a straight line is far from being
 “ the shortest way from one point to another, and
 “ that navigators only reach their destination by
 “ successively following a certain number of courses,
 “ which form greater or lesser angles with each
 “ other.

“ So that instead of steering directly for the Cape
 “ of Good Hope, mariners starting from Europe or
 “ the Atlantic ports of North America to go to
 “ India, must make the Canaries or the Azores;
 “ get into the track of the trade winds of the north-
 “ ern hemisphere, reach the coast of Brazil, and
 “ make Cape Frio, or put in at Rio Janeiro. It is
 “ only then that they can make for the Cape of Good
 “ Hope, better named, perhaps, Cape Tempestuous.
 “ They clear at length the Agulhas Bank, reach
 “ Bourbon or the Mauritius, and thence proceed to
 “ India in the track of the monsoon.

“ Vessels from the Mediterranean have still greater
 “ disadvantages to contend against. It frequently
 “ takes them a fortnight to pass the straits of Gibralt-
 “ ar, in consequence of the west wind which pre-
 “ vails in those straits, and the rapid current which
 “ pours the waters of the ocean into the Mediterra-
 “ nean.

“ The consequence is, that the passage to India
 “ takes at least from five months to five months and a

“ half. The passage back is rather more direct, without being to any perceptible degree shorter. The coast of Africa may then be followed more closely, thanks to the trade winds of the southern hemisphere. The place to put in at, in this case, is St. Helena.

“ If we now examine the conditions to which navigation is subjected in the three seas nearest to Suez, that is to say, the Mediterranean, the Red Sea, and the Gulf of Oman, we shall find that in the Mediterranean the winds blow from the north during the greater part of the year, change to the south by east towards the spring, and return to the north, passing by the west and north-west. The case is nearly the same with regard to the Red Sea, where the north wind, which is the most frequent, drives the waters in the direction of Bab-el-Mandeb, so that when the calm succeeds, a current is observed running north. This is evidently produced by the waters which had been raised in the south endeavouring to regain their level. The south wind usually succeeds the calm.

“ The Gulf of Oman has two monsoons, that from the north-east, which prevails with more constancy in the winter, and that from the south-west, which blows with force in summer. The change from one monsoon to the other is effected, there as elsewhere, by a series of calms and gusts of wind.

“ From these circumstances it would appear most advantageous to sail to India by the canal in summer and autumn, and to return towards the spring.

“ The great shortening of the distance between the ports of Europe, and those of India, is not the

“ only advantage which commerce will derive by
 “ frequenting the canal of the two Seas. In fact,
 “ vessels will not only reach their destination in a
 “ shorter time, but will meet on their route with
 “ numerous ports to put in at, and, what is more
 “ important still, considerable markets. The voy-
 “ ager, after having followed the easy track of the
 “ Mediterranean, will sell a part of his cargo in the
 “ Canal of Suez, or at Geddah; will buy ivory at
 “ Massaux, Souken and Berbera, which he will
 “ either exchange in India, for opium, or carry on
 “ to China to obtain silk or tea.

“ He will complete his homeward cargo with the
 “ colonial produce of Manilla, the Sunda Islands,
 “ and Ceylon, with cotton from India, or Egypt,
 “ with coffee from Abyssinia, or Yemen, with gum
 “ from Soudan or Hedjaz, with corn from Lower
 “ Egypt, or with rice from Damietta. And these
 “ multifarious operations, which now require years,
 “ will be safely and rapidly accomplished with little
 “ capital and small ships.

“ In fact, by reducing the time required for com-
 “ mercial operations we also reduce the general costs,
 “ make a much greater number of these operations
 “ possible in a given time, and, by that means, give
 “ facilities to small traders, by far the most numerous
 “ class.

“ By opening to navigation an easier and safer
 “ route, we bring into use ships of less tonnage, and
 “ more economically equipped; in one word, we throw
 “ open the road to India to the coasting trade—we
 “ DEMOCRATISE COMMERCE AND NAVIGATION.”

To these details, we will add our own personal

observations. We may say that the navigation of the Red Sea is always easy, from the straits to Raz Mohammed, because there are no rocks in the middle of the gulf, and it being always possible to beat when the monsoon is not favourable, and if some danger is to be feared at Raz Mohammed, from whirlwinds, currents and rocks, they will disappear as soon as a good lighthouse is erected, and a station of steam tugs established to assist vessels against the contrary winds.

Sailing may then be said to have attained the limit of its advantages, for it will profit by favourable winds to perform the transport service with economy ; and in those parts of the passage where difficulties are to be encountered, steam will come in aid, by which danger and loss of time will be avoided.

Another objection which has been raised against the direct canal is, that being cut through moving downs, it will soon be encumbered by them, and that the expense of keeping it in order, will consequently be so great, that it will be necessary to abandon it, if it ever be undertaken.

To refute this objection we will recapitulate the facts in their actual integrity.

From Suez to the extremity of the Bitter Lakes, the soil is, it is true, sandy at the surface, but however sandy it may be, the winds do not produce any modification in the superficial state of this part of the Isthmus.

This is to be accounted for by the fine sand being kept moist by the sea water, which reaches the surface by percolation and capillary attraction ; the

sand, which is out of reach of the moisture, is coarse sand, or rather small gravel, bound together by magnesian earth, in such a manner that the wind has no effect upon it. So true is this, that at several places in this desert we found, in December, 1854, the traces left by the tents of the engineers who were employed there in 1847.

The best proof that can be given of the stability of the soil in this part of the desert is the situation of the banks of the ancient canal, which still remain all along, as far as the Bitter Lakes. The torrents of rain which sometimes fall in this locality, may well, in 1200 years, have worn ravines in these banks, and partly filled the canal. In some parts even, the banks have been carried away by sudden torrents, but nowhere are they buried by the sand. Vestiges of antiquity, two or three thousand years old, may still be seen at the surface of the soil on the very line through which the canal is to pass. It is only on approaching Lake Timsah that moveable downs are met with, which surround and cut it in several places, changing their shape rather than their position; all the other downs which are met with in the form of chains of hillocks, and which occupy the space comprised between the bar of El Guisr and Pelusium, have long been naturally fixed by various plants, which have sprung up there under the influence of heat and moisture. It is, then, only the downs in the vicinity of Lake Timsah which require to be fixed artificially. Now, the fixing of downs has already become a special branch of industry presenting great advantages. The hills of sand which devastated the *Landes* of Bordeaux, and ad-

vanced every year into the interior of the country, rendering it barren, are now transformed into magnificent pine forests, which yield turpentine, pitch, various kinds of resin and timber.

This change, or rather this miracle, was effected by the simplest means. After an attentive examination of the facts, M. Bremon tier, engineer-general, to whom we are indebted for the fixing of the downs, had observed that, in digging at the summit of the most elevated downs, the sand was moist at a few *centimetres* from the surface.

Struck by this circumstance, he saw at once that vegetation would be possible, if the sand could be prevented from being displaced by the wind. He consequently imagined various means of obtaining this result, and his efforts were crowned with complete success. He sowed on several downs the seeds of the maritime pine, which have now become magnificent forests.

After being assured, by long experience, of the advantages which might be derived from the fixing of the downs, M. Bremon tier addressed a report to the Government of the Republic, in which are found the following valuations :—

“ The surface of the downs, which form the “ *Landes* of Bordeaux,” says he, “ being equal to “ 337,000 *Bordeaux journaux*, of 840 *square toises*, “ the amount required to fix the whole of these “ downs would be 8,000,000 *livres*. Now, a *journal* “ (0 *hect.*, 33) of sand planted with pines, gives an “ annual return of fifteen *livres*, that of 337,000 “ *journaux* would therefore be of 5,055,000 *livres*. “ It is supposed here that the *Journal* planted with

“ pines only yields three quintals of resin, and the
 “ price may be taken at five francs the quintal ; but
 “ the plantations, at the end of seven or eight years,
 “ will produce an immense quantity of combus-
 “ tibles, and afterwards charcoal, boards, timber for
 “ building, and finally tar. It is true that the pines
 “ are not of full value until twenty or twenty-five
 “ years after planting ; there will be, however, an
 “ interest of twelve and a half per cent. as a deduc-
 “ tion from all expenses.”

Much more simple means are employed at pre-
 sent, to fix the downs by sowing, for it is mostly
 considered sufficient to plant branches of broom,
 furze, or pine in quincunx upon the down to be sown
 and to scatter various seeds broadcast, and cover
 them lightly with a rake. These are called *tufted*
seed plots. The expense of a *hectare* is 66 *fr.*, 80,
 which is made up as follows, as appears from the
 accounts kept by the engineers entrusted with these
 works :—

460 faggots	at <i>fr.</i> 2,50 per C.	<i>fr.</i> 11,50
16 <i>Kilos.</i> pine seeds	0,45 . . .	7,20
2 . . . rush	2,50 . . .	5,00
2 . . . furze	0,25 . . .	0,50
6 . . . hay	0,10 . . .	0,60
Labour 1 day, 90. for a gang	22,10 . . .	41,99

Cost of 1 hectare . . . *fr.* 66.79

The gang is composed of—

A Foreman	<i>fr.</i> 2,00	<i>fr.</i> 2,00
6 Workmen	1,25	7,50
12 Women	0,75	9,00
6 Children	0,60	3,60

Total *per diem* *fr.* 22,10

At the eighth year they begin to yield interest on the capital and cost of keeping up (which is almost nothing), from the combustible that is obtained by removing the surplus, from making charcoal, &c. &c. At twenty years they begin to extract resin from the trees, at thirty years the produce is most abundant, and continues up to eighty years, when the wood is fit for building purposes. Then new seed plots are formed in proportion as the old trees are removed.

The annual produce of resin gathered from a *hectare* of pines is an average of five *metric quintals*, which, at the rate of twenty-two *francs* per quintal, gives a revenue of 110 *francs*, and represents at least seventy per cent. of the capital employed.

It will be seen by this statement, that the fixing of the downs has become one of the most productive operations of Silviculture, and that it offers one of the most advantageous investments for capital.

It was therefore necessary for us to know, whether the downs which cover the northern part of the Isthmus could be fixed by the same process. Now, we have ascertained, 1st. That the greater part of these downs are naturally fixed by a multitude of different plants, which have found sufficient moisture for their support; 2nd. That the moveable downs of the basin of Lake Timsah conceal moisture at a very little depth below their surface; they may, therefore, be fixed by seed plots, and to do it there is the immense quantity of bushes and shrubs which grow in the low parts surrounding the lake, and which give to that region the appearance of a copse.

Not only will sufficient branches be found on the spot for the tufted seed plots, but moreover, all the

combustibles for the lime, and for the wants of the workmen, will be furnished abundantly.

It is true, that at the time we made our observations (January, 1855), tolerably abundant rains had recently moistened the soil ; the success of the seed-plots, which would be destitute of moisture for the rest of the year, might therefore be doubted ; but what is there to prevent the moist season being chosen for making these plots ? and the seed once risen, the abundant moisture which is felt in this region, especially during the summer nights, will suffice to support vegetation, as is seen by the downs fixed naturally. Finally, to remove all objections, the fresh water canal which will end at Lake Timsah, will supply, if required, the means of affording, during the early days of the seed-plots, sufficient moisture for the success of the undertaking.

There is no possible doubt then as to the success which will be obtained in the fixing of the moveable downs, nor as to the pecuniary advantages which result from it, for the maritime pine answers well in Egypt, and other kinds of trees may be found still more productive. The cost of sowing will be less than in France, on account of the low price of labour, and the profits will be more considerable and more quickly obtained, on account of the hotter climate, and the consumption on the spot of all produce now wanting, and which is obliged to be procured from a distance.

We estimate the superifice of the downs to be fixed in this part of the Isthmus at about 2000 *hectares*, but if seed-plots and replantations were made upon all the downs naturally fixed, 100,000 *hectares* of

forest might thus be formed. It is for the Company to decide what extent of country it will be suitable to cultivate in this way. A final objection has been made to the Canal by assuming that steam navigation, by the agitation of the water which it produces, would quickly destroy the banks of the Canal,—banks formed in a moveable soil which would fill up the trough.

To guard against this inconvenience, which might, in fact, be apprehended, we have adopted very gentle slopes (two on the base line to one in height); then we have covered these slopes with stones for the whole height on which the agitation caused by the passage of steam-vessels could be felt. We have in our favour the example of the Caledonian Canal, thus furnished with a covering of stones formed of simple materials. This is what M. Flachet says, in the description that he gives of this Canal, according to the reports of the Commissioners of the House of Commons: “ Steam navigation especially demands attention. Difficult, perhaps even impossible, upon ordinary canals, where it causes an agitation which rapidly destroys the banks, it is organized on the Caledonian Canal, and presents nothing but advantages. With a speed of 11,000 to 12,000 *met.* per hour, all that has been observed is *a general splashing, which is not more than that produced by a moderately gentle wind.* The only precaution taken was, to collect on the banks and made ground all the large pebbles with which the land is filled, and to cover with them for a foot in height below the line of the water, the banks which, from the coarse composition of the

“soil, were too easily disturbed by the agitation of the waves. But wherever the ground had a good proportion of sand, there was nothing to be done.” Finally, it has been assumed, that the Government of Great Britain, yielding to a national prejudice, would put obstacles in the way of the project of cutting through the Isthmus, if it should be ascertained to be feasible, and that the English capitalists would not be disposed to concur in the undertaking. The future alone can show what truth there is in this assumption; we cannot at all conceive the opposition of the Government of a great nation to a project to which the English have especially, in these latter times, drawn the attention of the commercial world and their own Government on account of the special advantages which it offers to England. We have already referred to the writings of the traveller Bruce and those of Captain Rooke. We will now cite other names.

Captain James Vetch, of the corps of Royal Engineers, author of a very remarkable pamphlet published in London in 1843, and Mr. Clarkson, Civil Engineer, propose to trace the Canal in a single straight line from Suez to Tineh.

The editor of the Engineers' and Architects' journal (1844) in giving an account of the labours of these engineers, adopts in starting from Suez, the line of the ancient canal as far as the Bitter Lakes, and from the head of these lakes at Katieh he takes the direction of the Mediterranean in passing by the great lake Sulak el Bardoil.

The author adds, “It is hardly reasonable to reckon upon a union of the European powers to

“ effect an undertaking in which England has such
 “ a preponderating interest, in the point of view of
 “ our domination in India. It is true that all the
 “ Nations bordering on the Mediterranean would
 “ find large profit therein, but much inferior how-
 “ ever to ours.”

The Foreign Quarterly Review, one of the most esteemed periodicals of England, in an article where it treats of the cutting of the Isthmus, says that—
 “ the expense compared with the grandeur of the
 “ result is so trivial, that it is astonishing that the
 “ thing has not yet been done, either by a company or
 “ by the Viceroy. The advantages of this under-
 “ taking would be immense ; for, independently of
 “ the great commerce which would be done there,
 “ independently of the opening of Abyssinia and of
 “ the interior of Africa to the arts and civilization,
 “ the Red Sea abounds in natural riches, and the
 “ fishermen of the Mediterranean would transport
 “ themselves thither in crowds in pursuit of pearls,
 “ mother-of-pearl, tortoise-shell, sponges (the finest
 “ in the world), coral, fish oils, &c. &c.”

Mr. Anderson in his pamphlet already quoted, says : “ In a political point of view, the advantages
 “ which the English Government will derive from
 “ the Canal are almost incalculable. From Malta
 “ troops could be transported to Bombay in three
 “ weeks, to Ceylon and Madras in four weeks, and
 “ to Calcutta in thirty-five days at most, instead of
 “ the four or five months now required by a sailing
 “ vessel. Under such circumstances it would re-
 “ quire scarcely half the number of English troops
 “ for the efficient government of India. The facility

“ for despatching ships of war with munitions and
 “ men would thus increase the stability of the Bri-
 “ tish power, while the cost would be considerably
 “ diminished.”

“ In a commercial point of view, the advantages
 “ would be still more considerable: British India
 “ contains a population of 150,000,000, including,
 “ with the subjects of the British Crown, its allies
 “ and tributaries. China does not contain less than
 “ 350,000,000 of inhabitants: to say nothing of the
 “ other rich and populous countries of the East.
 “ Let us suppose that in consequence of the progress
 “ and developement of commerce, each Indian and
 “ Chinese should augment his outlay in the purchase
 “ of English produce by one shilling; this modifica-
 “ tion alone, insignificant as it appears, would aug-
 “ ment the amount of exports by 25,000,000. Now
 “ is it not evident that the opening of the Maritime
 “ Canal will greatly facilitate commercial relations,
 “ and tend to lower the price of all merchandize? the
 “ 500,000,000 of human beings peopling India and
 “ China are still sunk in ignorance and superstition.
 “ With steam navigation, which will be developed
 “ beyond all conception by the opening of the Canal,
 “ these people, brought into daily communication
 “ with European ideas, will enter by degrees into
 “ the current of science and civilization.”

We will terminate these quotations by an extract from a very remarkable work published in the “Papers for the People,” inserted in the *Revue Britannique* (for 1852), and in which the cutting through the Isthmus is regarded as a practical solution of the maintenance of the British power in India. We read there:—“ If

“ in spite of the concurrence of several adverse circum-
 “ stances, we firmly believe that our country will be
 “ able to effect the union of the two Seas, it is because
 “ this measure will soon become imperiously neces-
 “ sary for the maintenance of our empire all
 “ nations would find immense advantage in the crea-
 “ tion of a new route opened to navigation ; this evi-
 “ dent advantage, offered to the European states
 “ nearer to Africa, has even been seriously adduced
 “ as a fit argument to divert England from an enter-
 “ prise, the result of which might be problematical.
 “ We encounter here one of the old distrusts of that
 “ worn-out theory, that miserable tissue of mis-
 “ takes that took upon itself to teach, that a people
 “ is only rich and flourishing in proportion as its
 “ neighbours are indigent and unfortunate. Doubt-
 “ less the countries of Europe nearest to the East
 “ will derive a considerable profit from the opening
 “ of the Isthmus of Suez, but our egotism ought
 “ to find therein a motive for satisfaction ; for we
 “ cannot be ignorant of the fact, that the develop-
 “ ment of commerce, whatever the means employed,
 “ always ends by bringing the better part of the
 “ profits to the most intelligent and most numerous
 “ firms. For our own part, such is our belief.
 “ England, and more than one other nation by its
 “ example, appear to us called to great works which
 “ will throw into shade the most striking deeds of
 “ history. Among these works of the future, it ap-
 “ pears to us that the cutting through the Isthmuses
 “ of Panama and Suez stand in the first rank, and
 “ which multiplying and strengthening the ties by
 “ which people of all climates, of all races, of all

“beliefs are united to Great Britain, will connect
 “for ever the general prosperity of nations with the
 “happiness of our country, their security with its
 “power, their independence with its liberty.”

We believe we have abundantly proved the possibility of constructing the Maritime Canal with its two entrances, one from the Mediterranean, the other from the Red Sea, and its interior harbour at Lake Timsah. The facilities and advantages which it offers to commerce and navigation as well as to Egypt can no longer be a matter of doubt, and let us say with the illustrious author of the memorial upon the Nicaragua Canal:—“Think of the almost
 “miraculous effects which will be produced by the
 “annual passage across this fine country of 2 to
 “3000 vessels, which would exchange their productions for those of the East, and cause life and
 “riches to circulate everywhere. We may picture
 “to ourselves those shores, now so solitary, peopled
 “with towns and villages; those lakes now gloomy
 “and silent, furrowed by ships; those rugged lands
 “fertilised, and the interior canal carrying the benefits of civilization into the heart of the country.”

It only now remains to enter upon the financial and economical considerations of the undertaking; but before approaching this part of the question, it is necessary to complete the exposition of the scheme by describing the canal of communication and irrigation which will connect the interior of Egypt with the Maritime Canal.

This Canal must fulfil three conditions.

It should be of a section sufficiently large to admit the craft and steam boats that navigate the Nile, in

order to allow access to the interior harbour from all points of Egypt without the inconvenience of trans-shipment. The volume of water to be supplied to the Canal should be sufficient, after allowing for all losses by evaporation, infiltration, and the passage of the locks, for the irrigation of 100,000 *feddans* (40,000 *hectares*) during the winter, and 60,000 *feddans* (24,000 *hectares*) during the summer. Lastly, the level of the water ought to be maintained at the most favourable height for the natural irrigation of the immense tracts of land in the Isthmus which now remain barren for want of water.

To fulfil these conditions, the receipt of water for the alimentary and irrigating Canal may be established a little above Boulak at Kusr el Nil where the mouth of the Kalidj Zafranieh is, which loses itself to the north of Cairo in the Kalidj Manjeh, the ancient canal of Trajan and Amrou; this canal was partly re-excavated by Mehemet Ali to nearly the same dimensions as those required for the new Canal, and as far as Tell el Zoudieh. By following this track a great economy is already obtained. The Canal also exists farther on as far as Belbeïs, but of smaller dimensions; from Belbeïs, in order to maintain the water at a suitable height, the Canal is made to pass a little more to the East outside the cultivated lands, which will give the Company an opportunity of irrigating and fertilising the bordering tracts at present uncultivated. The canal then proceeds northward as far as *Ras el Wady* (head of the valley), the Pitoum of the Bible. This course exists of small dimensions, but in several parts of its route

it may be turned to account. There will not be great expense in completing the line as far as Lake Timsah; life would thus be given to Cairo by traversing it with a navigable passage, of which it is destitute at present. It would then be necessary, during the time of the low water, to raise the waters of the Nile to a height of three *metres* by means of steam pumps of 500 horse power; and when the barrage, for which His Highness Mohammed Saïd Pacha has a project, is completed, the reflux will facilitate, with the assistance of steam power, the introduction of the waters of the Nile into the Canal during the six months of the low waters.

The width of the Canal has been fixed at 25 *met.*, measured on the water line at the time of the inundation. This width is sufficient to allow two steam boats to pass each other without inconvenience. Moreover, precautionary measures may be adopted at the entrances of the locks, to prevent collisions, if it should become necessary hereafter.

The depth of the bed of the Canal below the natural surface of the ground in the first part or first dam, as far as the north of Tell el Zoudieh, is 7 *metres*, that is to say, at the level of the low waters of the river, and at 14 *metres* above the level of low water in the Mediterranean, the fall of the Canal has been fixed at 0,03 in a 1000 *metres*, in order to secure a speed that shall not exceed 0 *m.*, 65 per second, and that shall not destroy the banks of the Canal. This arrangement will enable us to supply, during the high waters of the increase, a volume of water for inundating the lands, of 40 to 50 *cubic metres* per second, or 3,500,000 to 4,000,000 *cubic metres per*

diem. As the inundation has to be continued during 100 days at the most, and each *feddán* of land ought to have a quantity of 8,400 *cubic metres* of water, that is to say, two *cubic metres* of water to each *square metre* of land, 47,600 *feddans* might thus be inundated during the 100 days. This quantity of water is given to irrigate the lands and leave upon them the deposits of the river, or the mud which is the manure of the Egyptian soil; but when the lands which the Company will bring into cultivation have been thus improved by two or three complete inundations, there will be a greater disposable quantity of water, and the number of *feddans* to be brought into cultivation may be augmented.

The lands being thus fertilised and cultivated in two ways; first by inundations as we have just said, afterwards by irrigation during the second part of the year, that is to say, during the low waters; then in order to secure sufficient water for the Canal of which the receipt of water is above the actual low water, steam machines will be employed at the backwater of the barrage.

In order to have during the heats of summer a volume of water that shall be sufficient for the irrigation of 60,000 *feddans* (24,000 *hectares*), for the loss by evaporation, and the waste at the last locks of Lake Timsah, there will be required—

<i>per diem</i>	^{met.} ^{cub.}
						1,200,000

For the passage of the locks, the dimensions of which are :—length 54 *met.*
breadth 12 *met.*
mean fall 3 *met.*

Brought forward	met. cub. 1,200,000
Taking forty passages <i>per diem</i> , the amount will be	80,000
For evaporation, infiltration and other losses, say 15 <i>per cent.</i> of the serviceable quantity, viz.	192,000
Total quantity of water to be supplied <i>per diem</i>	<u>1,472,000</u>

The height that the water has to be raised being 2 *metres*, and a pump of one horse power, raising 60 *litres* per second for one *metre*, pumps of five and six horse power will give the required quantity.

We establish therefore steam pumps of five and six horse power at the head of the Canal, as well as a barrage lock with gates both ways, in order to guard against the great risings of the Nile, and to retain the waters of the Canal when the river has subsided.

The Company will thus be able to fertilise 100,000 *feddans*, of which 60,000 will be by irrigation, and which will give the richest produce.

The Canal follows the course of the Zafranieh as far as Tell el Yaoudieh, where there is a lock of 2 *met.*, 50 fall; it then leaves this ancient water-course to the left as far as *Ras-el-Wady*: in this interval there are three other locks.

Leaving *Ras-el-Wady*, the track of the Canal is directed so as to keep it as high as possible, and to avoid the downs which occupy the whole of the valley, and are constantly moving from south to north: all these downs should therefore be fixed by seed-plots, and their superfice may perhaps be approximately estimated at 50,000 *hectares*. The

valley called *Wady-Tomilat* comprises two quite distinct parts; the first, from *Abasseh-Mollaut* to the east as far as *Ras-el-Wady*, is well cultivated; the other from this point, as far as Lake Timsah, is uncultivated and covered with shrubs, which will furnish an excellent combustible for the manufacture of lime and bricks, as well as for the requirements of the workmen, until it is cultivated. At present the waters of the Nile spread naturally during the inundation for half the distance from *Ras-el-Wady* to Lake Timsah. The *Ras-el-Wady* channel extends along the valley with a depth of 7 metres, and it opens into Lake Timsah with a double lock, forming together a fall of 7 metres.

Above this lock there is a water-course for irrigation running towards Suez, and a conduit of water on the Charmeroi system which goes towards Pelusium, so that, for the whole extent of the Isthmus, there will be water in abundance for the use of the workmen; the water-course for irrigation is 20 metres wide, 8700 metres in length, and has a fall of ,04 per kilom, which gives a difference of 3 met., 48 in the level.

So that at Suez the water-line of the water-course will be 7 met., 00—3,48=3,52. The depth of the canal being 1,50, it will be seen that its bed will be 2,02 above the level of low water, and near about that of high water. There will consequently be no fear of the infiltration of salt water.

The section of the water-course thus determined, will rule for one-third of its length, but its breadth will be reduced to 15 metres for a second third, and to 10 metres for the remaining third.

The water-course of Suez follows the direction and even the bed of the ancient canal, as far as the Serapeum, the culminating point of the bar of that name; it then leaves the ancient canal to the east, to avoid the sands, passes into a solid plain, makes the circuit of the grand basin of the Isthmus, arrives at the narrowest part, and continues in the plain at a sufficient height not to let the fresh water pass into the low and salt lands.

If on the Pelusiac side, a conduit of water has been adopted instead of an open water-course, it is in order to obtain fresh water more quickly for the whole length of the Maritime Canal, and because the tillage on the Pelusiac side does not begin until after that of Suez. And the pipes when they shall be replaced hereafter by a water-course, will serve to form a good distribution of water in the town which will arise at Port Timsah.

The advantages of the undertaking are now demonstrated. But it is not so with regard to the returns which it will give to the shareholders. Doubt is prevalent in the financial world, in consequence of the widely different estimates made by the engineers, both as to the cost and the probable returns. We have therefore directed our investigations more particularly to this capital point of the question, taking care to guard against every kind of exaggeration, in order to arrive at accurate and conscientious results, and at figures as near as possible to the truth.

We are now about to present the result of our investigations in this last part of our labours.

ESTIMATE OF THE COST.

ARTICLE I.

EARTH-WORKS.

WE have adopted in our calculations for the Canal, the depth of 6 *met.* 50 below low water, which will give for the *minimum* 7 *met.* 50, and for the *maximum* 8 to 9 *met.* draught of water, by the disposition of the locks and the elevation of the tides of the Red Sea. If this figure should not be found sufficient, it would be easy to increase it by the dredging machines, a certain number of which will always be kept, and which would not prevent the navigation of the Canal.

The total quantity of removal required for the excavation of the Grand Canal, according to the calculations made from

	<i>met.</i>	<i>cub.</i>
the sections, is	74,679,132	
Of which the part to be excavated to the level of low water in the Mediterranean is	17,473,790	
the remainder		57,205,342

is below this level.

EARTH-WORKS IN THE DRY.—For the first part, we have similar works executed in Egypt; these are the three Canals dug to receive the waters of the Nile arising from the reflux caused by the barrage. Two of these canals have a breadth of 100 *met.* at the

bed ; 4 *met.* 50 mean depth, with banks 25 *met.* wide. They are all three dug in clay, which is very stiff at some points.

The works having been executed by the Government, the pay of the workmen was very low : $1\frac{1}{2}$ *piast.* (0 *fr.* $37\frac{1}{2}$) was given to able workmen ; 1 *piast.* (0 *fr.* 25) to others, and 30 *paras* (0 *fr.* 20) to children ; the corresponding work done was 1 *met.* 25, cube *per diem*.

If this ratio were adopted, it would evidently be too low ; for the Company could not, and would not, exercise such an authority over the people of the country.

It is true, that these prices are voluntarily accepted by the fellahs in the villages ; but they are at home with their families, and are able to cultivate some patches of land on their own account. They would not willingly leave their families, unless to obtain higher wages, which would be at the *maximum*, $2\frac{1}{2}$ *piast.* (0 *fr.* $62\frac{1}{2}$).

An average of $2\frac{1}{2}$ *piast.* (0 *fr.* $62\frac{1}{2}$) *per diem*, must be reckoned upon, not including the supply of bread and water, which would cost 1 *piast.* in addition. Say, therefore, $3\frac{1}{2}$ *piast.* or in round numbers, 0 *fr.* 90.

At these wages, with good superintendence, 1 *met.* 50, cube *per diem* might be required ; for, in the works which we have carefully observed, we have adopted the formula $2 + n = 8$ *met. cub.* to fix the task of the workmen employed. In which formula *n* indicates the number of relays of 25 *met.* In the present case, supposing the average distance from the centre of removal to the centre of deposit to be two

relays, the formula would give 2 *met. cub.* and moreover the excavation is to be made in very light ground. We are therefore sure that the figure 1 *met. 50* cube, is rather below than above the mark. The cubic metre will thus come to 0 *fr.* 61.—At this rate the first portion of the earth-works would cost

fr. 10,484,274

ARTH-WORKS UNDER WATER.—For the second part we assume, that it will be done entirely by steam dredges, in two series. The first composed of dredges of twenty horse power performing the excavations to the depth of four metres; and the second composed of dredges of thirty-five horse power, making the excavations to the depth of 7 *met. 50*.

Let us see what can be done by both these working night and day for 250 days in the year; thus making ample allowance for repairs and stoppages.

The dredges employed at the barrage, of 20 horse power, and raising sand from a depth of seven metres, filled thirty-three lighters in the day and twenty-eight in the night, in all 61 *per diem*, giving a total of 610 to 700 *met. cub.*; but these machines were almost continually stopped for want of a sufficient number of lighters. These same dredges, on the

Carried forward . . . *fr.* 10,484,274

Brought forward . . . *fr.* 10,484,274

Seine, removed as much as 500 *met. cub.* in the day, and an equal quantity at night, excavating, it is true, at a depth of only 2 *met.* 50. The price paid per cubic metre was 0 *fr.* 75, including carrying away and discharging. At the barrage, on account of the low price of labour, the cubic metre has not cost 0 *fr.* 50.

For deepening the roadstead of Toulon, dredges of twenty-five horse power were employed, which raised the mud from a depth of 9 *met.* 50 below low water.

These dredges worked 270 days in the year, and each raised 194,755 *met. cub.* The cubic metre of soil extracted was fixed provisionally for the account at 1 *fr.* 20, including the transport and discharge, which was at an average distance of several miles in the open sea.

At the port of Valencia, dredges of thirty-five horse power were employed, raising 750 *met. cub. per diem*, from a depth of 5 to 7 *metres*. A steamer of seventy horse power towed the lighters to a distance of fifteen miles, and the cubic *metre* thus raised and transported only cost 0 *fr.* 75.

Carried forward . . . *fr.* 10,484,274

Brought forward . . . *fr.* 10,484,274

From these data it may be assumed, that the dredges of twenty horse power will raise 500 *met. cub.* of earth *per diem* from a depth of 4 *met.*, and we may fix the price of extraction, including transport, at 0 *fr.*, 75; that the dredges of thirty-five horse power will raise 750 *met. cub.* at 1 *fr.* By causing the dredges to work day and night, and assuming, as we have said, an average of 250 working days in the year, a dredge of twenty horse power will excavate *per ann.* . . . 250,000 and a dredge of thirty-five horse power 375,000

met. cub. 625,000

The total quantity of excavation to be performed by dredges being 57,205,342 *met. cub.*, if the work is to be done in five years, it will be necessary to have nineteen pairs of dredges; and, if it be observed that for the greater part of the Isthmus, the excavation may be done by hand to the depth of a foot at least below the level of the Mediterranean, since the bottom of the Bitter Lakes remains dry at a depth which reaches 8 *met.*, 58, it will be found that nineteen pairs will be amply sufficient.

Supposing half the work to be done

Carried forward . . . *fr.* 10,484,274

Brought forward . . .	fr. 10,484,274
by each kind of dredge respectively, the cost is found to be	50,054,674

CANAL OF COMMUNICATION.—The quantity of earth-work to be performed for the canal of communication and irrigation is calculated from the sections at 10,320,884 *met. cub.* from the receipt of water to Lake Timsah. For this work men will easily be found, at the rate of 3 *piast.* (0 *fr.* 75) including all expenses, and each workman will do easily 2 *met. per diem*, which reduces the price of the cubic *metre* to 0 *fr.* 37½.

The cost of excavating the canal will therefore be	3,870,331
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For the small canal of irrigation, leading from the last channel to Suez, the quantity of earth-work is 2,218,500 *met. cub.* For this it will be necessary to pay the men 0 *fr.* 90 *per diem*, and they will easily do 2 *met. 25 cub.*, which will be 0 *fr.* 40 *per met. cub.*

The cost of this part will therefore be	887,400
Add 10 <i>per cent.</i> for tools	6,529,667
Contingencies	173,654
Total for the first part	fr. 72,000,000

ARTICLE II.

WORKS OF ART.

To give a concise but accurate notion of the expense of the works of art, we shall fix the prime cost of the materials, compared with the prices paid in the execution of the works of the barrage, and then it will be easy to determine the outlay necessary for the present works, as compared with that of the former.

ROUGH STONE.—The rough stone used in the barrage comes from the quarries of Toura, situated 30 *kil.* from the place where it is used. It costs 22 *paras* the *quintal*, or 4 *fr.*, 20, the *cubic metre*, delivered on the spot. That which will be used in the works of the Maritime Canal will come from the quarries of Ataka, on the shores of the bay of Suez, at a distance of 20 *kil.* from Suez. This being a calcareous stone, like that of Toura, if it is brought to the boats by a railroad and towed by steamers, there is sure to be a saving in the extraction and transport. We have however, taken the price at 5 *fr.* to cover all difficulties in forming establishments, the higher rate of labour, and the cost of the railroad. This is the price paid for the blocks employed at the port of Cherbourg.

At the port of Valencia (in Spain), the extraction of large blocks, the transport to the quay and loading, only cost 4 *fr.* 25.

HEWN STONE.—The hewn stone for the barrage, came

from the quarries of Toura and Massara, at an average distance of 33 *kil.* from the place where used. These stones were first transported a distance of 6 *kil.* to the banks of the Nile, by means of bullock carts, then transferred to sailing barges, and carried by water to the distance above-mentioned.

The price per *cubic metre* was 24 *piast.* (6 *fr.*) for extraction, and 18 *piast.* (4 *fr.* 50) for carriage; in all 10 *fr.* 50.

For the works of the Maritime Canal, stone will be used coming from quarries now in work on the banks, at the level of high water for the whole extent of the Gulf of Suez, and also from quarries on the shore of the Red Sea, at a distance of about 10 *kil.* from Suez, which furnish a shelly calcareous stone, soft when extracted, but hardening by exposure to the air, and also in sea water.

This stone has been successfully employed in building the Grand Hotel of Suez, and has cost 33 *piast.* (8 *fr.* 25.) the *cubic metre*, hewn and delivered at the quay.

We have adopted this price, increased by 60 *per cent.* in order to cover the distance, and to arrive more easily at the comparison which we wish to establish.

BRICKS.—The bricks used in the barrage were made by steam machines, and cost, on account of extraordinary circumstances, 25 *fr.* per thousand. Those which will be made by hand or by means of bullock machines in the *Wady Tomilat*, will not cost half so much; for they can be made in the whole of that valley at the rate of 6 to 7 *fr.* per thousand, on account of the great quantity of combustibles found in that locality.

We have however assumed, that on account of the expense of transport, from Pelusium to Suez, the bricks will come to the same price, as at the barrage, which is evidently an excess.

LIME.—The lime cost at the barrage, 8 *fr.*, 70 the *cubic metre*, delivered on the spot. That which is made at Suez comes to 7 *fr.* 75 delivered. This lime is made in the valley of Guébé, with the combustibles found there in abundance, and which only cost the labour of cutting and transport.

POZZOLANO.—As the lime used in the barrage was fat lime, it was necessary to make artificial Pozzolano, which came to 45 *piast.* (11 *fr.* 25) the *cubic metre*. This Pozzolano could not be used for sea work, for we are convinced by experience that it is affected by the magnesia which is found in seawater. It can, therefore, only serve for the works of the canal of communication, and, like the bricks, it will cost less than at the barrage.

For the sea masonry, we have happily discovered solid masses in the harbour of Suez, anciently formed at the time of the Caliphs, or more probably at that of the Ptolemies. These masses of masonry are so compact, that when fragments are detached, the stone breaks more easily than the mortar, which is simply composed of sand and hydraulic lime.

This lime very probably comes from the mountains of Ataka, which contain several beds of calcareous marl; and there is no doubt that, by making researches, the beds that supplied the hydraulic lime may be discovered. Samples have been sent to M. Leplay, chief engineer and professor at the School of Mines, for analyzation, and more will be sent until good beds shall be found.

On this supposition, it is more than likely that the masonry of the Maritime Canal will be less expensive than that of the barrage, since it will be enough to have hydraulic lime to mix with the sand, which is found at all points of the Canal.

TIMBER.—The timber will come from Anatolia and Caramania. Oak and fir planks will be procured from Trieste. These materials will not cost more than at the barrage; for, though the distance of inland transport is greater, the expense of trans-shipment will be avoided by the construction of a new lock, which will unite the Mahmoudieh Canal, and consequently the Nile, with the sea.

IRON.—It will be the same with regard to wrought and cast iron, which will be procured from England and Russia.

Now, the barrage of the Nile is 1006 *metres* in length, with four locks, of which two are double, of 12 *metres* opening, and two others of 15 *metres*. It is established upon a general platform at 7 *metres* below the low water, is 46 *metres* wide, and four *metres* average thickness, with two lines of jaunting piles, and 1600 *metres* of quay walls, and only cost 18,000,000 *francs*, including the purchase of steam machines, to the number of twenty-two, the construction of all works and all the charges of administration, which were considerable.

If this amount is divided by the total length of 1006, 17,900 *francs* will be obtained for the cost of a running *metre*, including all the accessories of locks, quays, machines, and charges of administration.

BARRAGE LOCKS.—Adopting this figure, which is too high by a good third for the Maritime Canal, the two barrage locks and the oblique barrage, being altogether 300 metres in length, would cost

fr. 5,370,000

We say that this figure is much too high; 1st. Because the barrage was made to support a pressure of 4 to 5 *metres* of water, while those of the Maritime Canal will never have to sustain more than 2,50 *met.* at the *maximum* height of the water; 2nd. Because the waters of the Nile, rising to 7.50 *met.* above the low water line, it was necessary to elevate the masonry, piles, and arches, to make at the same time a bridge of passage, and to increase the weight of the masonry; 3rd. and lastly, Because it was necessary to defend the banks of the Nile by 1600 metres of quay walls, both at the approaches of the barrage and at the head of the three canals, which is not necessary here.

Notwithstanding these reasons, we have adopted the above figure, in order to obtain a result, rather in excess than below the reality, and thus to give every confidence in our valuations.

JETTIES AT PELUSIUM AND SUEZ.—For the jetties, both at Pelusium and

Carried forward . . . *fr.* 5,370,000

Brought forward . . . *fr.* 5,370,000

Suez, we have said that we should adopt the mode of construction by loose stones, as has been done in the greatest known works, and in the majority of the ports in the Mediterranean, such as Cannes, Bandol, Barcelona, Valencia, Cadiz, Genoa, &c. &c., always reducing the width of the causeway according to the necessity of the case. Thus, the jetty which is to windward in the prevailing winds, has a width of 8 *metres* at the summit for its causeway, which is at 1 *met.*, 50, above low water.

There is, moreover, a parapet 4 *met.* thick and 3 *met.*, 50, high. On the other hand, the jetty to the leeward has a causeway only 6 *metres* wide, and the parapet 3 *met.* thick and 2 *met.*, 50, high.

In order to enable the ships to approach the windward jetty, and to be towed its whole length, masonry in hydraulic mortar has been disposed on the interior slope of the jetty from a depth of 3 *met.* below low water, as shown on the section drawn on the map. This is only in imitation of what is seen in the harbour of Bastia, as well as in those of Cannes and Bandol, and the other details have

Carried forward . . . *fr.* 5,370,000

Brought forward . . . *fr.* 5,370,000
 been taken from those adopted in the
 construction of the last-mentioned.

Assuming that the jetty east of
 Suez will be 4000 *met.* long, there
 will be 970,000 *met. cub.* of rough
 stones, which at 5 *fr.* the *metre* on
 board the vessels, amounts

to *fr.* 4,750,000

Taking the transport and
 sinking at 2 *fr.*, which is a

great deal, we have . . . 1,940,000

Total *fr.* 6,690,000

Say in round numbers 7,000,000

For the western jetty, the same
 amount 7,000,000

For the jetty west of Pelusium, if
 we assume that the transport will be
 for a distance of 150 *kil.* at 0 *fr.* 03
per ton, per kil. which will be about
 0 *fr.* 06 *per cubic metre*, we shall have
 9 *fr.* for the cost of transport, to which
 add 1 *fr.* for sinking ; with the cost of
 extraction it will be 15 *fr.* *per cubic*
metre. The quantity being 1,000,000

met. cub. we get an amount of . . . 15,000,000

and as much for the western jetty . . . 15,000,000

MOLE OF PELUSIUM.—The defensive mole
 being 500 *met.* in length, its contents
 will be 250,000 *met. cub.*, and the cost

of its construction 3,750,000

RETAINING BASIN.—The semicircular

Carried forward . . . *fr.* 53,120,000

Brought forward . . .	<i>fr.</i> 53,120,000
dyke forming the retaining basin will have a developement of 6200 <i>met.</i> and the contents will be 890,000 <i>met. cub.</i>	
its cost will therefore be	13,500,000
The shingling on the banks of the canal for a length of 100 <i>kil.</i> is estimated at	1,500,000
QUAY WALLS OF PORT TIMSAH.—The quay walls to be constructed in the harbour of Lake Timsah, for a length of 1500 <i>met.</i> are estimated at 1200 <i>fr.</i> the running <i>metre</i> (though we have constructed some entirely of hewn stone, which only cost 850 <i>fr.</i>); the cost of this item will therefore be .	
	1,800,000
In order to ascertain in a general manner whether the figures which we exhibit are in conformity with the data resulting from experience, we have examined the costs of analogous works, that we might compare them with those which we have determined.	
The dyke of Cherbourg, which is 3800 <i>met.</i> long, has cost 68,000,000, after all the vicissitudes it has undergone from the beginning of the century. It comes therefore to about 17,900 <i>fr.</i> per running <i>metre</i> . Its depth is 18 <i>met.</i> , 80 below high water, while the average depth of those projected is only 4 <i>met.</i> Now if we	
Carried forward . . .	<i>fr.</i> 69,920,000

Brought forward . . . *fr.* 69,920,000

assume, as is evidently correct, that the bulk, and consequently the cost of each, are as the square of its height, we find that as the dyke of Cherbourg cost 17,900 *fr.* the running *metre*, those of Suez should cost twenty-two times less, that is 815 *fr.* yet they come to 1790 *fr.* the running *metre*.

The jetties of the harbour of Joliette at Marseilles, allowance made for all expenses, come to 5500 *fr.* the running *metre*. Their foundations are 11 *met.*, 50 below low water. Those of Pelusium ought, therefore, to cost nine times less, that is 615 *fr.*

The mole of the harbour of Valencia, which is 560 *met.* long, and the foundation 8 *metres*, 50, deep, was awarded for a sum of 3,000,000 *fr.*: according to this price the defensive mole of Pelusium should cost less than that sum, while we have estimated it at 3,750,000 *fr.*

The mole of the harbour of Cannes, which is only 150 *met.* long, has been estimated at 1,300,000 *fr.*, which is 8666 *fr.* per running *metre*, but it goes to depths of water that reach 10 *met.*: its cost is therefore, at least six times more considerable than that of the jetties of Suez; yet our estimate

Carried forward . . . *fr.* 69,920,000

Brought forward . . . *fr.* 69,920,000
is more than the fifth of that figure.

We may therefore say that our estimates are in excess as regards the works of Suez, and very much more so for those of Pelusium, since, in proportion, our figures exceed even those of works executed under the most unfavourable conditions.

CANAL OF COMMUNICATION.—For the canal of communication, we have first to erect pumps of 500 horse power in the aggregate, in order to provide amply for all the incidents of navigation, irrigation, losses by filtration and evaporation; as, for irrigation and navigation we only require 800,000 *metres cub. per diem*, while pumps of 500 horse power will supply 1,296,000.

STEAM PUMPS.—The steam pumps that have been erected in Egypt, have come to 2,200 *fr.* per horse power, fixed and mounted complete; for this item, therefore, there will be an expenditure of 1,100,000

BARRAGE LOCKS.—There will be six barrage locks with draw-bridges; the locks will be 12 *met.* wide and 54 *met.* long between the gates. The cost of each barrage lock complete will be 300,000 *fr.* and for the six . . . 1,800,000
Carried forward . . . *fr.* 72,820,000

Brought forward . . . *fr.* 72,820,000

CULTIVATION OF LANDS.—For bringing the lands into cultivation we must reckon 200 *fr. per feddan*, or 500 *fr. per hectare*. It is true that land may be bought in the country, all prepared with agricultural buildings, magazines, cattle, plant, &c. &c., at the rate of 250 *fr. the feddan* (625 *fr. the hectare*), but the agricultural system established on these lands is very defective.

The expenditure for 40,000 *feddans*, or 16,000 *hectares*, will be . . . 8,000,000

FIXING THE SANDS.—For fixing the sands we have seen that the cost would be 66 *fr.*, 80, the *hectare*. It appears to us advantageous to carry out this operation on a large scale; we have therefore adopted the figure of 24,000 *hectares* (60,000 *feddans*). The expenditure for this item will be . . . 1,603,200

CONDUIT PIPES.—For the conduit pipes, of which there will be a total length of 80,000 *metres*, we adopt those on the Charmeroi principle, although there are now earthenware pipes very suitable for water courses, and which do not cost half what the Charmeroi pipes do. These latter, 0 *met.*, 10, in diameter, which is the size adopted, are laid complete, including the

Carried forward . . . *fr.* 82,423,200

Brought forward . . . *fr.* 82,423,200
 trenches, 1 *met.*, 40 deep, at 6 *fr.*, 30
per metre. On account of the carriage,
 we put the *metre* at 8 *fr.*, which makes
 an amount of 640,000

LIGHT HOUSES AND BEACONS.—We as-
 sume that there will be two light-
 houses, one at the Damietta point,
 and the other on the Red Sea, at Raz
 Mohammed. There will be besides,
 two beacons at the head of the jetties
 at Pelusium and at Suez. The light-
 houses with their lenticular apparatus
 will cost, the two . . . 150,000 *fr.*
 and the two beacons . . . 20,000 *fr.*
 in all 170,000

There will be houses for the offi-
 cers, barracks for the workmen, sta-
 bles for the animals, magazines for
 the provisions, materials, &c. &c., for
 which we set down an approximate
 amount of 1,000,000

Total coast of Art. II. for Works of
 Art *fr.* 84,233,200
 Total cost of Art. I. Earth-works . . . 72,000,000
 Total cost *fr.* 156,233,200

We assume that it will require full
 six years to accomplish the works,
 and that the expenses of administra-
 tion will amount to two and a half
per cent. on the total cost; therefore
 for this item will be required a sum of 3,905,830

Carried forward . . *fr.* 160,139,030

	Brought forward . .	<i>fr.</i> 160,139,030
A farther sum for contingent works, unforeseen		2,410,970
	Grand total of the cost . .	<i>fr.</i> 162,550,000

DISTRIBUTION OF THE WORK.—Let us now see how this sum is to be expended, and in what manner the works may be distributed, in order to their completion in the space of six years.

The first thing to be done is, evidently, to bring the fresh water into the Isthmus, in order to supply the workmen, and to effect the transport of provisions and materials.

The canal of communication, with its locks, the irrigating channel, and the water conduit, may be easily executed in the first year, since these works only represent 12,539,384 *met. cub.*, or, at the *maximum* 6,269,692 days' work, at the rate of two *cubic metres per diem*. Taking 300 working days in the year, it will require 20,898 men. In this part of Egypt from 30 to 40,000 may easily be had if necessary.

In the same year the grand yards will be formed at the quarries, with all the railways, quays, and landing places, for the extraction and supply, on a large scale, of the stone necessary for the moles, jetties, and works of art.

Contracts will be made with the manufacturers for the supply of dredges, lighters, towing barges, boats, and other machines to be employed in the execution of the works. In this first campaign, the expenditure will be approximately 12,000,000 francs.

In the second year, eight dredges will be mounted in the harbour of Suez to excavate the channel and

the foundations of the jetties. The operations at the quarries, the erection of the jetties, and the barrage lock, may therefore be pushed on with all desirable activity.

Fresh water will be thrown into Lake Timsah, to set to work all the other disposable dredges ; 30,000 workmen will perform all the clearance in the extent of the Bitter Lakes, and for the remainder of the Canal. They will prepare a trench in the ground to 1 *met.* 50, below low water, and so form a channel 15 *met.* wide, which will enable the barges and machines to pass and repass the whole extent of the Isthmus. All the force will be applied this year to open a communication between Suez and Lake Timsah, and consequently between Suez and the Nile.

The fixing of the downs, and the cultivation of the lands, will be commenced. The expenditure of this campaign will be approximately *fr.* 25,000,000.

In the third year the communication of Lake Timsah with the Mediterranean will be opened, and all the disposable force will be employed in making the scouring basin and erecting the jetties. The earth-works will be continued, the dredging also, the sowings on the downs, and the agricultural labours. 20,000 workmen will be employed this year, and the expenditure may be set down at . *fr.* 30,000,000

In the fourth year, the same works as in the preceding, that is, the earth-works will be continued both by hand and by the dredges, the jetties, the barrage locks, and the quay wall in the Lake. Moreover, the defensive mole will be commenced ; the sowings and cultivation extended. It is estimated

that 20,000 workmen will still be required, and an expenditure of *fr.* 33,000,000

In the fifth and sixth years, the same operations will be continued, but so many men will no longer be required; for the dredges will perform the principal part of the work, and the operations at the quarries can then be pushed on with all possible activity.

We assume for each of these years an expenditure of *fr.* 31,000,000; for both . . . *fr.* 62,000,000
Which will make up the amount of the estimate
fr. 162,000,000

INTEREST TO BE PAID TO THE SHAREHOLDERS.—As it is usual to pay interest to the shareholders on the amounts subscribed, in proportion to the paid-up capital, it is necessary to take an account of the interest so accruing, and to carry the amount to the cost of execution.

Interest on 12,000,000 <i>fr.</i> subscribed the first year	
at 5 per cent. for six years . . .	<i>fr.</i> 3,600,000
— 25,000,000 2nd yr. 5 per cent. 5 yrs.	6,250,000
— 30,000,000 3rd „ „ 4 „	6,000,000
— 33,000,000 4th „ „ 3 „	4,950,000
— 31,000,000 5th „ „ 2 „	3,100,000
— 31,000,000 6th „ „ 1 „	1,550,000
	<hr/> <i>fr.</i> 25,450,000

Total of interest payable to the shareholders, to be added to the estimated amount of expenditure	162,550,000
	<hr/> 188,000,000

Let us, however, carry the *maximum* capital to be applied in the undertaking to *fr.* 200,000,000

In presenting the estimate of the works, amounting, as we have seen, to a *maximum* of 162,550,000 *francs*, we have been desirous of meeting, on the data generally admitted, all the objections hitherto made relative to the difficulties consequent upon the choking up of the entrance of the jetties and the accretions in the basin of the Red Sea or in the gulf of Pelusium. We have been fearful of appearing too bold in pronouncing, in an absolute manner, in favour of dispensing with the sluices and the works which they necessitate. We need not call attention to the fact, that the present is but a precursory scheme; we reserve it for our definitive scheme, to examine an entirely new theory founded on the experience of the most distinguished engineers of France, and on the conclusive opinion now before us of M. Renaud, chief engineer of seaports. We have hopes then, that it will be possible to dispense with the system of sluices, and that we shall thus effect an economy of several millions in the execution of the work. M. Renaud has ascertained that when the sluices open into the sea they lose nearly all their efficiency, and that in many cases they are worse than useless, and become detrimental. They deposit, in front of the channel, the matter which they bring down, and when this matter is not carried off by traversing or littoral currents, it forms, sooner or later, deposits or bars, whose summits are above the bed of the channel. It is thus that the mouths of rivers which flow into seas without tides, are, with few exceptions, without depth of water; the alluvium which is carried along the coasts coming within the action of the current of the river, is driven by that current to a cer-

tain distance from the shore, and deposited in proportion as the current loses its power. Being then less easily held in suspension than when near the coast, where the depth is less, they are also less easily carried off by the littoral current; deposits are formed and rise, until the combined action of the waves and the current no longer permit any fresh matter to subside.

Whatever may be thought of this explanation, it must be admitted that the alluvium brought by the sea, no less than that brought by rivers, prevents our obtaining a depth of water at the mouths of those rivers. Artificial sluices, therefore, appear to have no power to preserve a permanent depth of water.

If then we are permitted to renounce the idea of having recourse to the use of sluices for maintaining the depth of water at Pelusium and at Suez, it will be very easy by means of dredges to ensure the continuance of this depth, as is already done at the entrance of several ports, and particularly at that of the port of Cette.

The employment of dredges will allow of a considerable saving in the cost of establishing the Canal. The portion of the expenses required for the sluices would certainly be greater than the capital representing twenty times the annual expense of dredging.

Another saving (of 3,750,000) might be effected by dispensing with the intended breakwater or defensive mole at Pelusium. The channel as it is planned will probably be considered accessible in all winds which are likely to create a rough sea; there is no occasion then for us to trouble ourselves with the fear of seeing ships miss the entrance. There are a

great many important seaports, Alexandria for instance, where a ship cannot enter after sunset, in a much worse nautical condition than that at Pelusium will be, and near which nevertheless there is no sheltered anchorage. We may name the port of Liverpool, which is not accessible at low water for large ships. We may also mention the port of Havre, into which large ships can only enter during three hours out of twelve, and yet the number of disasters on those coasts is not relatively greater than elsewhere.

We have not deducted from the amount of expenditure any of the returns, which will be received during the execution of the works, and which will not fail to be important :—thus the inland Canal of communication being finished in the first campaign, there will be the transport of all the agricultural produce along it for five years. In the second year the Canal going as far as Suez, there will be, for four years, the lock dues and the profits of transport, which may be valued at an average annual value of 1,000,000 *fr.* There will be, moreover, the profits arising from the cultivation of the lands, which will increase every year, and will not be of less average annual value than 1,000,000 *fr.* This already makes an income of 8,000,000 *fr.*

Finally, during the last two years, passage may be afforded, as was done on the Caledonian Canal, to all ships of small tonnage, and to all steam boats that may choose to take advantage of the cutting, and in this manner a return of several millions will be obtained.

We might have brought these sums forward as a de-

duction from the interest payable to the shareholders, but we have preferred leaving them disposable.

ESTIMATE OF THE REVENUES.

It is impossible not to recognise *à priori*, the immense advantages offered to commerce by the new route that we present, and it appears from thence quite natural to assume, that the navigation formerly carried on in the Red Sea, and which continued to prosper, notwithstanding the discovery of the Cape, will resume yet more propitiously the ancient route ; since there will no longer be any trans-shipment, no longer any transport across the desert, no longer any obstacle whatever. Steam and sailing vessels will find, on the contrary, an opportunity of revictualling in Egypt with fresh provisions, which are found there in abundance at the lowest prices. Steam vessels will take in coals there, which will cost less by half than at present. Finally, travellers who now prefer the route by the Cape, on account of the inconvenience of trans-shipment, the fatigues of the desert of Suez, and the high price of the passage, will no longer hesitate to adopt the shortest line, when it shall be more easy, more certain, and more economical than the other.

There are, however, timorous minds from which has emanated the opinion, that the Maritime Canal at the best, could only serve for steam navigation, for sailing vessels would find, according to them, no advantage from the moment they should be subjected to passage dues ; and the proof, they say, is, that the

rate of freightage has sunk so low *viâ* the Cape, that it could bear no deduction arising from any passage dues whatever.

Let us therefore examine the facts attentively, in order to resolve this question in a manner at once clear and practical that shall remove all doubts.

In treating of the navigation on the Red Sea, as compared to that on the ocean, to reach India, we think we have demonstrated that at present, with the means of steam-towing, with the aid of lighthouses, and the knowledge acquired of the winds, the currents, and the coasts of the Red Sea, a sailing vessel will meet with more facilities on this latter, than on the Ocean in the passage of the Cape; but let us admit the circumstances to be equal on either side, by way of the Canal 2000 leagues at least are economised in the passage between Europe and the regions of the extreme East. This saving is equal to a saving of two months out of five. For, in making the passage of 480 leagues from Marseilles to Alexandria, the ships consume ten days on the average at the favourable season.

A diminution of two months out of five, must necessarily produce a corresponding advantage in all the expenses which press upon merchandize: thus—

1. The average value of imports and exports between Europe and the extreme East, being about 600 *fr.* per ton, the saving in the interest, on the capital employed at the rate of six *per cent.* will be 6 *fr.* per ton.

2. A ship of 500 tons burthen, costs at the least, fully equipped, 150,000 *fr.*, and pays seven *per cent. per ann.* to the assurance companies when it navi-

gates the Chinese waters. It only makes at present two voyages in the year including the return; with the Maritime Canal it will be able to make three, which will effect a saving to the owner of two *per cent.* that is 3000 *fr.* or 6 *fr.* per ton.

3. The capital represented by the ship ought to yield an interest arising from the freight, of at least twelve *per cent.* on account of wear and continual reparation. By enabling the ship to make an additional voyage, the Canal gives the means of saving four *per cent.* that is, 6000 *fr.* or 12 *fr.* per ton.

4. This same ship has a crew of fifteen men, exclusive of the captain. Taking the pay of each man at 70 *fr.* per month, and that of the captain at 600 *fr.*, it will be found that a saving will be made of 2500 *fr.* which is 5 *fr.* per ton.

5. Although it may be said that the insurance upon merchandize is not determined by the duration of the voyage, but by the risk which the ship runs, according to the route it takes; we do not the less ~~persist~~ in maintaining that the facilities of navigation in the Red Sea being at least equal to those *vid* the Cape, the rate of insurance must be lower upon merchandize exposed two months less to the chances of navigation. This rate is usually two and a half *per cent.* upon merchandize going to China; we do not think we are beyond the truth in assuming a diminution of half *per cent.* in favour of the passage by the Canal, which would be a farther saving of 3 *fr.* per ton.

By adding up the figures thus obtained, we find a saving of 32 *fr.* per ton on merchandize which shall pass by the Canal: this *minimum* figure of

32 *fr.* calculated for a diminution of 2,000 leagues, will increase in proportion to the distance gained by the ports nearest to the cutting ; for Constantinople, for instance, the saving will be more than double, on account of the 4300 leagues gained by her navigation. Leaving 22 *fr.* of the increased profit to the advantage of navigation, there will remain 10 *fr.* per ton for passage dues in favour of the Company, a figure which is less than two *per cent.* on the estimated average value of the merchandize, at 600 *fr.* per ton. Now, silks, indigos, coffees, sugars, tobaccos, gums, cottons, woollens, wines, spirits, &c. &c. are of greater value than this figure ; there is only rice and coal which do not reach it.

It will doubtless be objected to our calculations, that the freights to Australia being on an average only 50 to 60 *fr.* per ton on merchandize, if the 32 *fr.*, which we show as an advantage presented by the Canal, were forestalled in the freight, there would only remain 20 to 30 *fr.* per ton for the shipowner, who would evidently suffer loss. It will thence be concluded that our valuations are exaggerated. But at present the shipowner who despatches his vessel to Australia at the rate of 60 *fr.* per ton, is equally at a loss by the merchandize ; and if he consents to make the speculation, it is for the advantage that he finds in the freight of the passengers. Well, the speculation will not be altered by opening the Canal ; the shipowner will still lose on the merchandize and gain by the passengers : only he will lose less than at present by the one, and gain more by the other. It is the same for China and the other parts of the extreme East. The freights are so low in relation

to the distance and the chances of navigation, that loss appears to result from them. But it is clear that then the shipowners are interested in those operations of commerce that are very lucrative, and are moreover indemnified by the passage of numerous emigrants, functionaries, &c. &c. The opening of the Maritime Canal, far from being hurtful to these operations, will, on the contrary, be eminently advantageous to them, and the shipowners will find their ultimate profits increased by it. Our calculations, therefore, remain intact, since they are based upon practical data, known to every one, and which are, moreover, according to the general usages of commerce.

Let us now endeavour to give an idea of the commerce in imports and exports, which is carried on between Europe and India, China, &c.

Trade has so much increased for a period of ten years, and especially during the last three years, in consequence of the discovery of gold in Australia; and every year its developement is such, in relation to the preceding year, that it is impossible to settle its statistics even approximately. For the figures given for one year are already erroneous before they make their appearance. It is, however, possible to throw some light upon this question, which has been the subject of so much controversy, and to give a *minimum* figure.

Mac Culloch, in his statistics of 1842, gives the following figures for the tonnage of merchandize imported and exported by the commerce of England.

	<i>Imports.</i> Tons.	<i>Exports.</i> Tons.
Cape of Good Hope	4950	16,408
Eastern Coasts	152	240
Ports of the Red Sea	—	409
Islands of Cape Verd	1118	2883
St. Helena and Ascension	330	3977
Mauritius	28,650	16,397
Singapore and Ceylon	191,378	202,101
Java	2346	8672
Philippine Islands	3411	301
Other islands of India	1141	686
China	32,818	28,297
Australia	22,865	51,234
New Zealand	1341	9651
Islands of the South Sea	388	1018
	Tons 290,888	342,274
		<u>290,888</u>
Grand total . . .	Tons	<u>633,162</u>

Mr. Anderson, of the East India Company, estimates the tonnage of English ships in relation with the places dependent on the East India Company, for the year 1841 at . . . Tons 727,587

Deducting the commerce with the Cape and the other places in the vicinity, estimated at . . . 30,309

There remain, Tons . . . 697,278

To which he adds the tonnage of the ships trading to Batavia and the other Dutch and German possessions . . . 200,000

Grand total . . . Tons 897,278

Thus Mr. Anderson gives, probably for the same year, a tonnage greater by a third than Mr. Mac Culloch.

We will now compare some of these figures with those that have been officially collected by M. Arnaud Tison, delegate from the Chamber of Commerce of Rouen, in his travels in China during the years 1850-54.

In 1851, 976 ships entered the ports of Australia, measuring Tons 234,215

In the same year 1014 ships cleared the ports, measuring . . . Tons 263,894
Total, tons 498,109

This figure is seven times greater than that given by Mr. Mac Culloch, and as the discovery of gold was not yet made at that time, it may be said that at present the figure given by M. Arnaud Tison ought to be doubled to be correct. The total value of imports and exports was 110,000,000.

For China, the single port of Shang-Hai exported in 1851, 35,000 tons of tea, which is more than the figure given by Mr. Mac Culloch for all the produce imported from China.

The commerce of the two single ports of Shang-Hai and Canton, in imports and exports, without reckoning opium, was estimated in 1851 at 400 to 500,000,000 *francs*, which answers nearly to 800,000 tons, taking the average value per ton at 600 *fr.*, and which makes twelve times as much as the estimate given by Mr. Mac Culloch.

At Manilla, the commerce in 1851 was 51,773,232 *fr.* of which about 24,000,000 were exports, and the remainder imports. This figure answers to the activity of 86,300 tons, taking the average value of the ton at 600 *fr.* It is more than twenty times the estimate of Mr. Mac Culloch.

For Java we have not been able to procure any positive information, but according to the periodical publications (*Revue des deux Mondes*, &c.) and according to the reports of travellers, the increase of business every year is much greater than in the Philippine Islands. We shall not therefore be charged with exaggeration, in fixing the figure of commercial activity in these colonies at 100,000,000 or about 150,000 tons, for the year 1851.

Mr. Anderson estimated the commerce between Europe and Indo-China at £26,000,000, or 650,000,000 *francs*, thus distributed:—

The commerce between Europe and the Indies is estimated at	Exports	£12,000,000
	Imports	8,000,000

The commerce with Singapore, China, Java, &c. &c. at	6,000,000
Amount of the commerce with places to the east of Egypt	<u>£26,000,000</u>

We have just seen from the researches of M. Arnaud Tison that Shang-Hai and Canton alone gave to commerce in 1851 an activity represented by the figure of 400 to 500,000,000 *francs*, which is quadruple that attributed by Mr. Anderson in 1841, to the entire commerce of the China Seas, including the Philippine islands, Java and Singapore.

We are therefore quite sure of being below the reality in fixing the amount of commerce with places to the east of Egypt, in 1851 at 100,000,000, instead of the 26,000,000 in 1841. At the time we write, this figure of 100,000,000 sterling is perhaps quadrupled and carried to 10,000,000,000 *francs*,

and when the Canal is opened, this latter sum will be a mere mistake.

In fact not only the greatest part of the commerce of Europe with the extreme East will be carried on through the Maritime Canal, but moreover all the activity in operation between America and China, will abandon the route of Cape Horn for that of the Isthmus, which will be easier, shorter, and more certain.

For the farther support of our opinion, we have the vast countries which are at present completely without the sphere of the commercial activity of the world, and which, upon the opening of the Canal, will furnish a contingent which cannot be estimated now, but which will be considerable. Abyssinia, Yemen, Hedjaz, Mascata, and the coasts of Africa, will deliver quantities of merchandize; such as the coffee of Yemen and Abyssinia, gum arabic, wax, skins, ivory, wool, indigo, &c. &c. Mules and animals for the slaughterhouse abound in Abyssinia, and are sold at a low price. A mule may be had from 25 to 100 *fr.*, an ox for 10 *fr.*, a sheep for 3 *fr.*; timber and cabinet woods abound in the vast forests which have never felt the axe. Along the coasts of the Red Sea are very rich mines of sulphur, which have just begun to be worked; lead mines, quarries of marble and porphyry; extended beaches suitable for the establishment of salt pits, &c. &c.

New occupations will arise, such as whale and cachalot fishing in the South Seas; pearl fishing in the Persian Gulf and Indian Sea, as well as the pursuit of mother-of-pearl, tortoise-shell and coral. A great part of the Mediterranean fishermen will

transport themselves to the Indian Sea, to pursue their occupation, and increase the activity of the navigation in the Maritime Canal.

We may therefore be sure that the cutting through of the Isthmus will increase ten-fold the operations of commerce and navigation; that, as with every undertaking based upon a true principle, the consequences cannot be calculated, and that the idea most exaggerated in appearance, will always be surpassed by the reality.

As, however, we are addressing ourselves to the commercial world, and have to convince all minds, even the most timid, it is necessary that we should fix upon a figure, and that this figure should not startle any one. We have adopted that of 4 milliards (4,000,000,000) of francs, answering to 6,000,000 tons, which, according to what we have been showing, is without doubt, already exceeded at present, or certainly will be, before the close of the undertaking.

We have likewise assumed that of the 6,000,000 tons, 3,000,000 only will take the route of the Canal.

If we had followed the method of estimating adopted in the railway schemes, it would be necessary to make a statement of all the merchandize exchanged between Europe and America on the one part, and Indo-China on the other; then to multiply the figure thus obtained by a coefficient, never less than 3, and which sometimes reaches to 10. The result of this operation would give an enormous product, nevertheless probable. But to remain within the circle of ordinary ideas, instead of tripling the actual figures, we have diminished them by half.

The commercial activity obtained according to these bases, will produce an annual revenue from passage dues, at 10 *fr.* per ton, of *fr.* 30,000,000

For anchorage dues at Port Timsah, from half the total number of ships, which we suppose will stop there, 1,500,000 tons, at 1 *fr.* per ton . . . 1,500,000

The canal of communication with the Nile, supposing it only transports a fourth of the merchandize which traverses the Mahmoudieh, will show an activity of 15,600 tons of merchandize, which may easily pay 10 *fr.* per ton, since at present it costs 27 *fr.*; 50 *fr.* from Cairo to Suez, by Canal, and the journey takes three days. The transport by barge may be done at the rate of 12 *fr.*, 50; there will remain an advantage of 5 *fr.* by way of the Canal, and the journey will be two days less. This item will therefore bring in a revenue of . . . 1,560,000

The cultivation of the lands produces on an average 100 *fr.* *per feddan*, or 250 *fr.* *per hectare*, as results from the labours of seven years, which one of us employed upon a tract reclaimed from the marshy desert of Lake Etko.

Supposing the Company brings into cultivation only 60,000 *feddans* (24,000 *hectares*), it would receive a return of . . . 6,000,000
Carried forward *fr.* 39,060,000

Brought forward *fr.* 39,060,000

The downs which cover the southern part of the Wady and the north-eastern part of the Isthmus, as well as those of Lake Timsah, are to be fixed. Let us assume that the Company will perform the operation extensively, and carry the figure to 60,000 *feddans* (24,000 *hectares*). We have said that the *hectare* gives at the end of 20 years, a *minimum* return of 100 *fr.*

By making the allowances to ascertain the actual revenue, it is reduced to 41 *fr.* 50, per *hectare*, which for 24,000 *hectares*, is

996,000

Grand total of annual returns from the Canal

40,056,000

From this amount must first be deducted two and a half *per cent.* for the charges of maintenance and administration, and one *per cent.* for redemption, in all three and a half *per cent.*

1,201,680

Balance *fr.* 38,854,320

The Government's share fixed at fifteen *per cent.*

5,828,148

The founding members' share fixed at ten *per cent.*

3,885,432

9,713,580

Balance in favour of the shareholders

fr. 29,140,740

Representing a dividend of about *ten per cent.*, over and above the interest of *five per cent.*, taking the capital at 200,000,000 *fr.*

We pass over in silence a multitude of sources of revenue, which will not fail to be pretty considerable ; such as the supply of water to the population of Suez and Port Timsah, the rent of stations for watering ships, the rent of all the magazines and buildings, which have been employed in the execution of the Canal, the towing of vessels by the steamers purchased by the Company for the service of the dredges and the transport of materials.

There are other branches of revenue that will acquire great importance hereafter ; among others, the fishing in the Canal, the produce of the works to be established at the fall of each barrage lock, and the sale of Arab horses.

The current established by the action of the two barrage locks, will draw into the Canal a multitude of fish, both from the Red Sea and the Mediterranean.

The falls of the fresh water Canal will be made available to the agricultural operations of the country, such as grinding corn, husking of cotton, peeling of flax, laying of thread, &c.

The situation of the Isthmus of Suez, upon the confines of Arabia and Syria, which supply the best breeds of horses, and whither Europe has always had to repair to regenerate the equine species, will become a locality, than which none can be more favourable for the formation and maintenance at a trifling expense, of an establishment for breeding and rearing horses. The valley *Wady Tomilat* will again become

what it was in the times of Scripture, the land of *Goshen*, which name signifies in Hebrew and Arabic *Pastures*; the land that Joseph prevailed upon Pharaoh to grant to the Israelites, *because it was the most fertile country in Egypt*.

We are so convinced that the preceding estimates of revenue will be rapidly exceeded, that we propose to the Company to have a clause inserted in the Statutes by which the tariffs shall be lowered as soon as the dividends shall exceed twenty *per cent.*, in order to make the community of the world participators in the advantages of this grand and useful undertaking.

With this last observation we will terminate our labours, which are only, as their title indicates, a preparatory work, intended to fix public opinion upon the merits of the undertaking, and to lead discussion on to a limited and well defined ground.

These labours will be followed by a regular scheme, wherein all the details of execution will be developed, and wherein the most recent statistical documents, drawn from official sources, will furnish the basis of all the calculations of revenue.

We have confined ourselves in this preliminary exposition to the establishment of the approximate *maximum* presumed expenditure, and we have sought to guard against any exaggeration in estimating the revenue. All our calculations are based upon documents, which any one may verify and appreciate at their worth.

We entertain the hope, that the undertaking will be favourably received, for there will be profit and honour for those who take the first part in it; and

it will not only offer incontestable advantages, but it will be moreover the grandest work of progress and of civilization that the nineteenth century will have produced.

Cairo, 20th March, 1855.

(Signed) Linant *Bey*. Mougel *Bey*.

LETTER FROM THE
GRAND VIZIER RESHID PACHA
TO HIS HIGHNESS
MOHAMMED SAID PACHA,
VICEROY OF EGYPT.

Translation from the Turkish.

The 12th of the Month of Djemazul Akhir 1271.

(1st March, 1855.)

YOUR very humble servant has the honour to address you as follows :—

M. Ferd. de Lesseps is about to return to your Highness. He is indeed, as your Highness was graciously pleased to observe to us, a guest who of himself deserves all possible attention and consideration. His object in coming here had reference to the affair of the Canal ; an undertaking of the most useful character. During his stay in Constantinople, I have had the pleasure of seeing him several times, and of conversing with him at length on various subjects. He has had the honour of being presented to his Majesty the Sultan, by whom he was received with the highest favour.

In conformity with the Imperial order on the subject of the Canal, the question of this interesting undertaking is now under the consideration of the

Council of Ministers. M. de Lesseps, not being able to wait until the end of the conferences, has decided on taking his departure. I shall shortly have to acquaint your Highness in detail with the result.

(Signed) **MOUSTAPHA RESHID.**

REPORT TO HIS HIGHNESS
MOHAMMED SAID PACHA,
VICEROY OF EGYPT.

The Camp, Marea, 30th April, 1855.

I HAD the honour of submitting to your Highness the memorial of your Engineers MM. Linant *Bey*, and Mougel *Bey*, for the construction of the Canal of the Isthmus of Suez.

This is intended as a precursory scheme for the cutting through the Isthmus. It is accompanied by a map indicating the configuration of the ground and the nature of the soil. It has met with your Highness' approval, and you have requested me to give it the most extensive publicity in order to call the attention of all competent persons in Europe and America to a question which interests the whole world, and to invite their examination and observations.

* * * * *

Your Highness has decided to send immediately, to the Counsellors of His Imperial Majesty the Sultan, the explanations which they require for the ratification of the scheme for the communication of the two Seas.

For my own part I shall proceed immediately to Europe, I shall make it my especial business to get the official documents relative to the affair as well as the precursory scheme of MM. Linant *Bey*, and

Mougel Bey, printed and published. Arrangements will be made in order to collect within a limited time the opinions of those competent persons who shall be willing to aid the enterprise with their information and suggestions. In the mean time your engineers will be preparing the elements of their definitive scheme.

Agents will be appointed in every country to collect the communications and arrange the correspondence.

When the definitive scheme of the engineers is completed, and when the remarks received from each country have furnished a mass of information, a commission will be appointed, composed of engineers of known ability in hydraulic operations, and chosen in England, France, Germany, Italy and Holland. This commission will give its opinion upon the scheme of your Highness' Engineers, and point out the modifications, or alterations which it shall think proper to be adopted. Every means shall be placed at the disposal of the Commission for visiting the Isthmus of Suez, should it be considered necessary to see the localities before deciding.

Your Highness has been pleased to limit at present the consideration of the track. After having passed in review the numerous schemes presented to Governments, or to the public, for more than fifty years, you give full liberty for the application of the means that science shall recognize to be best for making a communication between the Red Sea and the Mediterranean, by cutting through the Isthmus of Suez at any point of the Isthmus, eastward of the course of the Nile; but you have declared that you will

not authorize the Grand Maritime Suez Canal Company to adopt any track that might have its point of departure on the coast of the Mediterranean eastward of the Damietta branch, and which would cross the Nile.

It will not be until after the adoption of the track of communication between the two Seas, and when all the advantages and all the responsibilities of those who take part in the enterprise are clearly determined, that capitalists and the public will be invited to subscribe for shares, and the representatives of those interested will finally decide upon all questions affecting the administration, the execution and carrying out of the undertaking.

Allow me now to point out to your Highness, the preparatory operations to which MM. Linant *Bey* and Mougel *Bey* have to apply themselves previous to presenting their definitive scheme.

They have—

1st. To trace out on the ground the line of the Maritime Canal in detail, with all its angles and curves, and transfer the line so traced on to a plan.

2nd. To take the levels throughout this line, extending them into the two Seas to a depth of ten *metres* of water.

3rd. To make profile sections wherever the formation of the ground requires it.

4th. To take soundings along the line, and carry them out to a depth of ten *metres* below the level of low water in the Mediterranean.

5th. To collect specimens of the various soils met with in their operations.

6th. To settle the prime cost of manual labour

and of all the materials that will be employed in the construction of the Canal.

7th. To establish positive data that will serve to estimate the number of workmen of all kinds necessary for the execution of the works.

For my own part, I shall make it my business to collect the most recent statistical documents that will afford the means of ascertaining positively the *minimum* valuation of the returns.

When the time has arrived for commencing the works of the Maritime Canal, a large number of machines, and a considerable quantity of materials, timber, iron, coal, &c. &c., ought to be procured from Europe. The Suez Canal Company will find the advantages of certainty, economy and facility of transport, which do not exist at present, in the continuation of the railway to Suez, and the establishment of the Towing Society, with which is connected the amelioration of the Mahmoudieh Canal, and also its communication with the port of Alexandria.

* * * * *

The communications which I have received from Europe bear witness to the ever-increasing interest with which the scheme of opening the Isthmus of Suez is everywhere received.

Amongst those who have spontaneously offered me their co-operation, there are some who have placed considerable sums at my disposal as a contribution to the preliminary expenses of the undertaking. These offers already amount to more than 15,000,000 francs. I have not thought it proper to avail myself of them, but I have noted the names of those

who have made them in order that they may take their appropriate place in the list of subscribers.

Certain founding members have already been named ; they have subscribed an engagement, under conditions, to contribute to the expenses preliminary to the regular organization of the Company. The first list of founding members, fulfilling the conditions required by Art. 11, of your Highness's Firman, contains fifty-five names belonging both to Egypt and to Europe. Your Highness who leaves to me the charge of completing this list by the addition of persons of all countries who shall actually contribute to the establishment of the work, has desired that the total number should not exceed 100 if it can be avoided.

Your Highness has been pleased to approve of the provisional appointment of M. Ruysenaers, Consul General of the Netherlands, as principal agent of the Company in Egypt ; he deserves in every respect this mark of confidence.

Such are the preliminary proceedings that have appeared to your Highness calculated to promote the success of your grand enterprise.

I beg your Highness to inform me whether I have fully understood your intentions.

(Signed)

FERD. DE LESSEPS.

MY ATTACHED FRIEND M. FERDINAND DE LESSEPS,
OF HIGH BIRTH AND ELEVATED RANK.

I HAVE made myself acquainted with the report which you addressed to me on the 30th of April, and I approve the document which is to serve you

in place of instructions. I appreciate the zeal which you have displayed in this affair, and the friendly interest you have taken in it has afforded me real satisfaction.

3 Ramadan, 1271.

(The Viceroy's Seal.)

A true translation of the Turkish text.

KÖENIG BEY,

Secretary of Mandates to His Highness
the Viceroy.

Alexandria, May 19, 1855.

OPINION OF MR ANDERSON.*

THE interest which has recently been manifested in the improvement of our means of communication with India, China, &c. *viâ* Egypt and the Red Sea, seems to have revived the speculations, first broached during the occupation of Egypt by the French forces under Napoleon, as to the feasibility of opening a communication between the Red Sea and the Mediterranean by a Canal through the Isthmus of Suez.

Various statements upon this subject have lately appeared in the newspapers and periodicals, both of this country and the Continent, and a kind of prospectus proposing the formation of a Company to execute the undertaking, has just been put in circulation in London.

These statements and speculations, in so far as they have come under the cognizance of the writer of the following pages, are, in a great measure, superficial, crude, or erroneous,† and, therefore, cal-

* Extracts from *Communications with India, China, &c. Observations on the Practicability and Utility of opening a Communication between the Red Sea and the Mediterranean, by a Ship Canal, through the Isthmus of Suez. By Arthur Anderson.* London, Smith, Elder & Co. Cornhill, 1843.

† Since writing this, an article on the "Suez Canal" has appeared in the *Foreign and Colonial Quarterly Review*, which, although containing some inaccuracies of minor importance, and professing only to take a general view of the subject, the writer would exempt from the above description.

culated to mislead rather than inform the public in regard to the practicability and utility of an enterprise, whose importance it is scarcely possible to overrate, considering the nature and magnitude of the interests which would be involved in its successful accomplishment.

The writer has had the means of obtaining information relative to this matter, which he considers may be relied on, and having devoted much of his attention to this Canal question, he deems the present time opportune for submitting to the public some facts and observations tending, he ventures to believe, to lead to more correct conclusions on this very interesting subject than any which have as yet been published.

These facts and observations will be found arranged under the following heads :—

- 1.— *The physical practicability of the enterprise.*
- 2.— *The political arrangements requisite for effecting it.*
- 3.— *The advantages or disadvantages of navigating by the proposed Canal route, as compared with the route by the Cape of Good Hope.*
- 4.— *Financial considerations.*
- 5.— *General observations as to the political, commercial, and moral benefits which would be derived from the accomplishment of the undertaking.*

That facility of intercourse creates commerce, and commerce carries with it civilization, is an axiom founded on universal experience.

Where seeming exceptions to it are found, they may be traced to the blind selfishness of human legislation, counteracting the natural laws established by the all-wise and beneficent Governor of the universe.

A project, therefore, which, by severing two continents, proposes to change the whole course of commerce and communication between the eastern and western worlds, and approximate by many thousand miles the knowledge and industry of the west to the ignorance and barbarism of the east, presents considerations of a nature to excite the imagination, and to awaken some of our best feelings in its favour.

In dealing with it, the writer, however, purposes to limit himself to a strictly practical view of the subject. He will state his facts with accuracy,—place every circumstance, whether for or against the undertaking, as far as his information enables him to judge, impartially before the reader,—and thus leave him to form his own opinion as to the practicability of accomplishing the contemplated enterprise, and of its utility should it be accomplished.

The writer deems it proper to add, that the matter was some time since submitted by him to the consideration of Her Majesty's Government, and that the extract from M. Linant's Survey of the Isthmus, herein given, appears in the "*Commercial Tariffs, Regulations, &c., of Foreign Countries, part 10, presented to both Houses of Parliament, by command of Her Majesty, 14th July, 1843,*" being part of those valuable compilations, for which it is well known the country is indebted to the talents and industry of Mr. Macgregor, of the Board of Trade.

PHYSICAL PRACTICABILITY OF THE ENTERPRISE.

THE improvement of our communication with the East has been, for some time past, an object of much public solicitude, and in proportion to the progress made in its developement, its importance becomes more and more manifest. The establishment of a steam communication with India, &c., *viâ* the Mediterranean and the Red Sea, although as yet only in its infancy, has already been productive of considerable benefit, both to Great Britain and her Oriental dependencies.

But, although the steam communication presents a greatly improved means of transit by this route for passengers and letters, it cannot, except in a comparatively very limited degree, be made available for the general purposes of commerce. The transport of all articles of merchandize of moderate value, compared to their bulk or weight, must, from the small stowage-room afforded by steam vessels, and the expense of the transit across Egypt, continue to be effected by means of sailing vessels navigating by the long and circuitous route round the Cape of Good Hope.

The principal object, therefore, of the contemplated Canal, would be to open a shorter route between Europe and the East, which could be availed of by sailing as well as by steam vessels, and thus serve the general purposes of commercial intercourse.

Previously to proceeding to treat of the practicability of opening such a canal, it may be proper to

explain how it has fallen to my lot to deal with this subject :—

In the year 1841, I visited Egypt. While there, my attention was, among other matters, directed to the question which has so frequently been mooted, although never hitherto, I think, satisfactorily treated, viz. the practicability of re-opening the ancient Canal through the Isthmus of Suez, said to have once joined the Red Sea and the Mediterranean.

In following up this object, I became acquainted with M. Adolphe Linant, of Cairo, a French Civil Engineer, of considerable reputation, and who has been in the employ of the Pacha of Egypt, for, I believe, upwards of twenty years.

I found that M. Linant had devoted a great deal of time and labour to the practical investigation of this subject, had recently completed an elaborate survey of the Isthmus, and was in possession of much detailed information derived from a personal examination of the localities through which the proposed Canal would have to be cut. Under certain conditions I induced him to furnish me with a memoir on the subject, accompanied by a manuscript map of his Survey of the Isthmus of Suez, and of Lower Egypt, in which the site of the ancient and track of the proposed Canal are laid down with great minuteness. In short, the map, now in my possession, which is on a large scale, contains a far more complete view of Lower Egypt than any hitherto executed.

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POLITICAL ARRANGEMENTS.

THE co-operation, or, at least, the concurrence of the Pacha of Egypt would be indispensable.

Having suggested the expediency of the interposition of one or more of the European powers to remove any political impediments which might stand in the way of this enterprise, it appears necessary to take a brief view of the interest which they would each have in promoting it.

Great Britain, from the vast extent of her commerce and political connections with the East, would, undoubtedly, derive the greatest advantage from it; but most of the other nations of Europe would derive benefit in proportion to the extent of their commerce; and those, having ports in the Mediterranean and Levant, or indeed anywhere nearer to the proposed communication than the ports of Great Britain, would gain more in proportion.

Holland, next to Great Britain, would, from the extent of her trade with the East, have a direct interest in the accomplishment of the proposed enterprise. Her commerce would be improved, and her political connection with her extensive colonies of Java, &c., would be much strengthened by it.

France would derive most important benefits. It would create almost a new commerce for her, in which, through her ports in the Mediterranean, she would have the advantage over us in importing direct the indigo, &c., of India, of which she requires such large quantities for the use of her manufacto-

ries, while the shorter route which would be opened to India, &c., would give a stimulus to her exports.

Austria, there is every reason to believe, would give a cordial support to the undertaking. She is making active and judicious efforts to extend and improve her commerce ; and there is little doubt of her co-operation in promoting an undertaking so well calculated to further her views in that respect. The merchants of Trieste have been the first to avail themselves of an arrangement which the writer of this succeeded about two years since in effecting with the Pacha of Egypt, by which he agreed to relinquish the high rate of transit duties in Egypt, imposed by the treaties with the Porte, and to substitute as low a rate of duty as would admit of the transit through Egypt of goods to and from India, &c. Under this arrangement, two cargoes of India produce have been already brought from Bengal to Suez in sailing vessels, thence transported across Egypt to Alexandria, whence they were brought to Trieste.

The Chamber of Commerce of that port are, it is well known, anxious to extend their trade with the East in this direction ; and it is stated, that a proposal was, a short time since, made by some Austrian capitalists to the Pacha, for opening a Canal through the Isthmus.

Greece would obtain a decided benefit by it. Her numerous small vessels would be well adapted for trading with the ports of Africa and Arabia in the Red Sea, and they would soon be seen covering these coasts.

Italy, Turkey, Spain, Portugal, Belgium, the minor northern states, and even America, would all

participate more or less in the improved route for eastern commerce, and, taking a just view of their own interests, would hail it as a benefit.

Even *Russia*, although possessed of an over-land communication with Central Asia, India, and China, would gain an advantage by the Canal, as she could open a maritime intercourse with the east through her ports in the Black Sea, which would be less costly, and susceptible of greater extension than a land transit.

It hence appears, that all the European powers would have an interest, more or less, in promoting this enterprise ; and there appears to be reasonable grounds for concluding, that if requested by one or more of the first-rate powers, either to undertake the work himself, or permit it to be undertaken by private capitalists, under such an arrangement as would connect his name with it, and secure to himself and his descendants a pecuniary benefit from it, as already suggested, Mehemet Ali would be induced to co-operate in it.

The guardianship of such a passage between Europe and the East, would serve to enhance the importance of his political position, and to strengthen those relations of mutual interest between the ruler of Egypt, and the communities of Europe, which would form the most efficacious guarantee for the continuance of the Government of Egypt in the family of Mehemet Ali.

The association of his name with so magnificent an enterprise, would, I consider, be another powerful motive to a man so ardently imbued with the love of fame.

Should a firman or other formal act from the Sultan of the Ottoman Empire, in his character of sovereign of the soil, be deemed requisite for securing a permanent and indisputable right to make and keep open the Canal, I should suggest that point being left to the management of the Pacha, who, I have some reason to think, would obtain it much more easily and promptly than if it were attempted through the medium of European diplomacy.

ADVANTAGES OF NAVIGATING BY THE CANAL ROUTE,
AS COMPARED WITH THE ROUTE BY THE CAPE OF
GOOD HOPE.

BEFORE entering on a comparison of these two routes with regard to their navigation by sailing vessels, it may be well to consider what advantages the contemplated Canal would afford in facilitating the steam communication with the East *via* Egypt and the Red Sea, commonly, though very erroneously, denominated "the Overland Route."

In order to make this properly understood, it will be necessary to give a brief account of the present arrangements for the transit through Egypt of the mails, passengers, and packages, to and from India, China, &c.

It is, no doubt, generally known, that this communication is carried on by the steamers of a private Company, which ply monthly between Southampton and Alexandria, touching at Gibraltar and Malta, and by smaller steamers belonging to the East India

Company, which ply monthly between Bombay and Suez, chiefly for the purpose of conveying the mails. The private Company have now also placed two steam ships, the "Hindustan," and the "Bentinck," of 1800 tons, and 520 horse power each, to ply between Suez and Calcutta, touching at Aden, Ceylon, and Madras. The vessels of that Company, both on this side of Egypt, as well as on the other side, convey goods as well as passengers, and the mails; but the East India Company's vessels plying between Suez and Bombay, do not receive goods, and have but limited, and comparatively inferior accommodations for passengers.

The mails, passengers, and packages, are, of course, disembarked from the steamers coming from England at Alexandria, and are re-embarked at Suez in the steamers proceeding to India on the outward route, and *vice versâ* on the homeward route.

It now remains to show how their transit across Egypt, between Alexandria on the Mediterranean, and Suez on the Red Sea, is effected, with the present cost of it, in order to estimate how far it would be improved by the contemplated Canal communication.

I shall now proceed to consider what advantages the Canal would present to sailing vessels navigating between Europe and the East.

The distance from the English Channel to Calcutta, *viâ* the Cape of Good Hope, by the route taken by the best sailing vessels, may be put down at miles 13,000

<i>Via</i> the Mediterranean, the Red Sea, and Indian Ocean, it is about . . .	<i>miles</i> <u>8,000</u>
Gain in distance by the latter route, to or from Calcutta	<u>5,000</u>
By the Cape route to Bombay it is about	11,500
By the Red Sea route	6,200
Gain in distance to or from Bombay . . .	<u>5,300</u>

This is, of course, assuming the navigation by the Mediterranean and Red Sea route to be of equal facility with the Cape route. And I shall now endeavour to examine this part of the question with the accuracy which its importance demands.

The first point which presents itself in this consideration, is the influence of the monsoons, or periodical winds, which prevail throughout the Indian Seas, and in the southern part of the Red Sea.

The south-west monsoon, which blows much stronger than the north-east monsoon, prevails in the Indian Ocean, between the east coast of Africa and the coasts of India, &c., from May until October, blowing with the greatest force during the months of June, July, and August.

The north-east monsoon prevails from October to May, but is of much less force than the south-west monsoon.

In order to estimate the difficulties or advantages of these periodical winds, to a sailing vessel navigating by the Red Sea, as compared with the route by the Cape of Good Hope, we must, for vessels bound to or from the most important commercial ports in India—the Presidencies of Madras and

Bengal, as also Ceylon, Singapore, Java, China, &c., suppose her placed at a point a few degrees to the southward of Ceylon from or to which she would have to proceed, whether navigating by the Cape of Good Hope, or by the Red Sea route.

Now, it is well known, that from this position a vessel steering for the coast of Africa towards Cape Guardafui (the southern extremity of the Gulf of Aden), and thence to the Straits of Bab-el-Mandeb (the entrance of the Red Sea), would carry the wind a-beam, and could therefore make her passage to or from the Straits of Bab-el-Mandeb, and the given point to the southward of Ceylon, during the whole of the south-west monsoon.

As the north-east monsoon blows in an exactly opposite direction to the south-west monsoon, and is much more moderate, a sailing vessel could make good her course between the Red Sea and the same point south of Ceylon, equally well as in the south-west monsoon, and therefore during the whole year could effect this part of the passage with tolerable certainty.

Vessels proceeding to or from Bombay would have to arrange their passages to suit the monsoons. Sailing from England, or other places in Europe, so as to have the south-west monsoon in their favour ; and sailing from Bombay for Europe so as to have the north-east monsoon in their favour.

It hence appears that the monsoons present no particular difficulties in the voyage between India, &c. and the entrance of the Red Sea, more than in the ordinary route by the Cape of Good Hope ; but that, on the contrary, for ships trading with the eastern

and most important parts of Hindostan, and to Ceylon, Malacca, Singapore, Java, China, &c. this part of the voyage would be made with more certainty than an equal distance in the Indian Ocean, of a voyage by the Cape of Good Hope route.

THE RED SEA PASSAGE.

THE length of the Red Sea from the Straits of Bab-el-Mandeb to Suez is 1200 miles, its medium breadth about 150 miles, and its direction nearly N. N. W. and S. S. E.

Its coasts on either side are fringed with coral rocks, which render it dangerous in navigating it to approach near its shores.

In the southern part of it, say from the latitude of Jidda to Bab-el-Mandeb, being about one-half of its whole length, the southerly monsoon predominates nearly two-thirds of the year, commencing in October and ending in May or June. The northerly winds then set in, and continue about four months, say June, July, August, and September.

Outside the Red Sea, in the Gulf of Aden, the wind generally prevails from the eastward for six months, say, from October to May, and from the westward during the other part of the year.

In the northern part of the sea, from Jidda to Suez, but more particularly near to Suez, the prevailing winds for nine months of the year are northerly, and in the months of June, July, and August, it is very difficult for sailing vessels to beat up to Suez. In this part of the Red Sea southerly breezes are at all times but of short duration.

The best time for vessels to sail from Suez for India, &c. is therefore about the end of August, which will enable them to clear the Straits of Bab-el-Mandeb in September, before the easterly winds commence in the Gulf outside.

From all these facts it will appear,

1st. That the passage between India, &c., and the Gulf of Aden, may be made with ordinary facility by sailing vessels.

2nd. That some delay would be experienced by sailing vessels in the Gulf of Aden during certain portions of the year, whether bound to or from India; and also by vessels *coming from India*, in the northern part of the Red Sea, during the greater part of the year.

Against these difficulties in the Red Sea route must, however, be set off the delays by calms and contrary winds, between the trades experienced by vessels navigating by the Cape route. In order to ascertain how nearly they may balance each other, and consequently whether a saving of time in navigating by the Mediterranean and Red Sea, proportionate to the shorter distance, as compared with the voyage round the Cape of Good Hope, might be effected, I would beg leave to submit the following questions to the consideration of experienced nautical men.

1st. Is the navigation by a sailing vessel, between England and Pelusium, say 3000 miles, of equal facility as a similar distance from England on the Cape route?

2nd. Is the navigation to or from the given point, to the southward of Ceylon and Cape Guardafui,

more certain than that of an equal distance between the same point and the Cape of Good Hope?

3rd. Would the impediments in the navigation of the Red Sea and Gulf of Aden, already pointed out, be greater or less than those experienced from calms and contrary winds between the trades in navigating by the Cape of Good Hope route? And, assuming that the answer to the second query should be in favour of the Red Sea route, would that gain set off against the difficulties of navigating the Red Sea and Gulf of Aden, and reduce the latter to a par with the impediments between the trades just alluded to?

4th. Would not the nature of the coast of Egypt, at the embouchure of the Canal in the Mediterranean, present considerable difficulty and danger to sailing vessels approaching it for the purpose of seeking the Canal entrance? The coast, it is well known, for a distance of upwards of 150 miles to the eastward, as well as to the westward of the Canal entrance, is destitute of any sheltered anchorage, is exceedingly low, and not easily discoverable until within a short distance of it, and very shallow at a distance of two leagues from the shore. A good light on the pier or breakwater might obviate some of the danger, but still it is to be apprehended, that sailing vessels approaching this part of the coast, with the wind strong from the north and north-west, and which is very prevalent, would incur considerable risk of getting embayed and being driven ashore.

If the result of this investigation should be such as to place the difficulties and facilities of each route on a par, it will then follow that a gain in time of

from four to six weeks would be effected in navigating to or from India, &c. by the proposed Canal, as compared with the Cape of Good Hope route.

Before concluding this part of the subject, I think it well to advert to another objection which may possibly be raised against the Canal passage, namely, the difficulty of tracking a vessel of heavy burthen through the Canal, from the Mediterranean to the Red Sea, against a current of three to four miles an hour, which would be the velocity of the stream constantly flowing from the Red Sea to the Mediterranean.

To this may be answered, that the same northerly winds which prevail as already stated, for the greater part of the year, in the upper or northern part of the Red Sea, also blow across the Isthmus, and consequently the vessel would be for the most part able to stem the current by using her sails. In default of this, a sufficient number of dromedaries would track a vessel of almost any size, or posts placed along the banks of the Canal for warping would effect the object on occasions, which would be of but rare occurrence, of a failure of wind.

It is to be considered also, that as the beds of the Bitter Lakes and of the Lake Timsah, would form two very extensive basins in the course of the Canal, nearly half-way between the Mediterranean and the Red Sea, these would become halting places or inland ports, and here steam tugs would no doubt, among other accessories, be found, should the Canal ever become a general channel of intercourse.

From the Red Sea to the Mediterranean the vessel would, of course, be carried along by the stream.

GENERAL OBSERVATIONS AS TO THE POLITICAL, COMMERCIAL, AND MORAL BENEFITS WHICH WOULD BE DERIVED FROM THE ACCOMPLISHMENT OF THE UNDERTAKING.

IN a political point of view, the facilities which the Canal passage, combined with steam navigation, would afford to Great Britain, as regards the government of her Indian empire and dependencies, are almost incalculable.

From Malta troops could be placed in Bombay in *three weeks*; in Ceylon and Madras in four weeks; and in Calcutta in five weeks. And by means of the frequent intermediate coast communication in India, which the extended and comprehensive plan of steam navigation anticipated to result from the opening of the Canal passage would afford, troops and stores could be rapidly moved from one station to another.

Let any military man compare this with the present mode of effecting similar operations. The long sea voyage by the Cape of Good Hope, of four or five months, in a sailing vessel;—the men worn out, and requiring almost as many months more after debarkation, to recruit their health and strength, so as to be fit for active duty;—the length of time, and great fatigue, in moving between distant military stations;—and I think he will admit, that India might, with the facility alluded to, be efficiently governed with one-half the number of European troops which is

now required. The facility for despatching ships of war, and stores of all kinds, to or from India, &c., need only be glanced at to be at once appreciated. The stability of British power in India would be thus increased, while the cost of maintaining it would be considerably diminished.

To estimate the importance of the proposed communication in a commercial point of view, it is necessary to take into consideration the extent of the field of operations for commerce, which the vast and populous regions of the East present. India contains 100,000,000 of subjects of the British Crown, and there are 50,000,000 of adjacent tributaries and allies; in all, 150,000,000 in the Peninsula of Hindostan, exclusive of the island of Ceylon. Little has as yet been done to stimulate the people to improve their resources and ameliorate their condition and habits; but of late years more attention has been directed to these objects, and the trade with British India has been rapidly on the increase.

China contains, it is estimated, not less than 350,000,000 of inhabitants, said to be inclined to industry, and to be peculiarly addicted to traffic. A timid and jealous system of government has for ages hermetically sealed, as it were, this vast country and population from intercourse with the rest of the world. British valour has now removed the barrier, and opened this almost new world to European commerce.

Let us suppose that the people of India and China should, from improved intercourse, require to the extent of one shilling *per annum*, for each individual, in value of British manufacture or produce. Even

this seemingly insignificant amount would produce an annual increase of 25,000,000 in our exports. The opening of the Canal route would tend greatly to facilitate our intercourse with the 500,000,000 of people who inhabit India and China, and hence its commercial importance must be sufficiently obvious.

The application of steam power to the purposes of navigation, is doubtless one of those mechanical discoveries destined to effect a great moral revolution in the human mind throughout the world. The printing press has contributed, in an immense degree, to the progress of civilization, by furnishing a means for the spread of thought. But it seems scarcely to admit of a question, that the power of steam, applied to navigation, will exercise a more extensive, a more rapid, and a more efficacious influence in accelerating the civilization of the world than even the printing press.

Five hundred millions of human beings inhabiting Hindostan and China remain to this day enslaved by debasing superstitions, and sunk in mental darkness and delusion. What a field is here opening to the Christian philanthropist! To aid in the removal of ignorance and superstition by the diffusion of useful knowledge, and an enlightened religion; to plant industry and the arts where indolence and barbarism have hitherto prevailed, are noble efforts, tending no less to elevate those who engage in them, than the object of their exertions. The opening of the proposed communication would obviously subserve the promotion of such objects, and therefore can scarcely fail to excite an interest in the mind of every sincere well-wisher to his fellow creatures.

The preceding statement and observations will, I trust, be sufficient to show that the object of which they treat is, at least, of sufficient importance to warrant an effort being made to ascertain, in the manner suggested, whether it be practicable or not, and if found practicable, whether, and in what manner, the Pacha of Egypt would be disposed to concur or co-operate in it. If the information and suggestions therein given should lead to such a result, the chief object of their publication will be attained.

OPINION OF CAPTAIN JAMES VETCH, R.E.*

A GOOD deal is alleged by those trading from Britain to the East Indies against the policy of any part of the British nation lending patronage to such an undertaking, which, it is presumed, would benefit the countries bordering the Mediterranean more than our own ; though, if the canal in question would be the means of most materially shortening the distance between the two most important portions of the British Empire, little doubt can be entertained of the benefit conferred on the extensive commerce of the two countries, even though some other nations would receive a greater proportional advantage in the accomplishment of the measure ; and though the commerce of other nations might increase in a greater ratio than the British, still all would participate in facilities to be obtained ; and in the case of war arising, it is but too obvious, that the power possessing a naval superiority has the means of closing such a channel of commerce to its enemies, by stationing cruisers at each extremity. So much may be urged with a view of removing the prejudice

* Extracts from *Inquiry into the Means of establishing a Ship Navigation between the Mediterranean and Red Seas. By James Vetch, Capt. R.E., F.R.S. London, Pelham Richardson, 23, Cornhill, 1843.*

of British interests against the measure ; but it will readily be believed, that if the British fail to patronize the undertaking, other nations and powers will do so shortly : and it is therefore manifest, if British subjects were chiefly concerned in advancing the capital, and in executing and managing this great work, it would be vastly more for the benefit of Britain, than if any other nation or Government lent their resources. But undertake it who may, it is most probable, that both the funds and the energies of execution will come from this country ; and it is too probable, that if the measure is executed by any other parties than British, the work will be upon a cheaper and less effective plan of navigation, permitting only small craft to navigate, unfit for British commerce in the East, though sufficient for the small traders in the Mediterranean, who would consequently, in such a case, reap the entire benefit. I am decidedly of opinion, that British capital and British energy would alone execute the work in a truly useful and permanent style. But the measure is daily becoming so much more obvious as one of practical facility, that it cannot long be postponed in some shape or another.

The conclusions may now be recapitulated in general terms :—

1st. That a ship canal between the two Seas, which contemplates an extended commerce between the countries of Europe and the Indian Ocean, should be free from the effects of all fluctuating causes, arising from inundations or floods, &c.

2nd. That it should be a measure irrespective of the commerce of Egypt and the Nile, or rather that

it could not combine these objects in the same measure, with any good results ; though it would be the means of greatly improving the commerce of Egypt by accessory measures.

3rd. That the mean fall from the level of the Red Sea to that of the Mediterranean (say thirty feet) is sufficient to keep the artificial channel clean, if the fall be properly economised ; and also that it would be able to preserve its mouth in the Bay of Pelusium in a navigable state at all seasons.

4th. That a navigation of still water with locks could not be long maintained with advantage, under all the circumstances of the case.

5th. That a broad and deep stream like that of the Dardanelles could not be produced by natural operations, assisted slightly by art ; but that the attempt would be pregnant with mischief in some quarters, and result in disappointment.

6th. That a direct and perfectly controllable channel, of a uniform size and shape and incline, would be the safest and most appropriate undertaking of which the circumstances permit, and under the imperfect information we possess.

It must, however, be confessed, that no definitive opinion can be given, or very satisfactory estimates assumed, until a new and detailed survey, having the express objects in view, is completed, comprehending the necessary levellings and borings and maritime surveys of the ports at the termini of the Canal.

With respect to the land survey, were all the necessary persons and means duly prepared to commence operations in the beginning of October, it is

probable the investigation might be completed in the beginning of the following May, and a true solution given to this great geographical, commercial, and engineering question.

As mankind multiply and make progress in arts and civilization, new wants arise, and the ingenuity and industry of man is taxed to discover new sources of wealth, maintenance, and occupation: and we find, under the dispensations of an all-wise Providence, that at suitable seasons resources are unveiled which have been long provided but concealed until the fit occasion presents itself. Amongst the numerous administrations of the same wise and merciful design, it is not unreasonable to believe that the completion of navigable channels across the Isthmuses of Suez and Darien are enterprises amongst the events designed to minister to the growing wants and improvement of the human race.

In the preceding pages an endeavour has been made to show the superiority of a direct communication between the two Seas (which would provide for the speedy passage of large ships at all seasons), over a communication partly through the medium of the Nile, which would be interrupted in the dry season, and prove tedious at all times; and it now remains to say a few words on the comparative value of railways.

Railways, under present circumstances, would expedite the transmission of passengers by the steam ships across the Desert, and might be useful in the transmission of light and valuable goods between the Nile and the Red Sea; but it must be greatly doubted

if a sufficient traffic could thereby arise to pay the construction and maintenance of eighty miles of railway between Cairo and Suez. On the other hand, were it contemplated to construct a railway between the bay of Tineh and Suez, the cost, including the improvement of the harbours at either terminus, would nearly equal the expense of the proposed Canal ; but the *means* of keeping the terminal harbours deep and clean would be foregone from want of means of scourage ; and to the expense of the railway would have to be added the expense of unloading and reloading the cargoes of each shipment ; so that it is manifest that a railway direct between the two Seas could stand no competition with the proposed Canal, which, besides its value as a commercial channel, would facilitate the steam navigation with India in the highest degree, by permitting the steamers to make a continuous voyage ; and by permitting supplies of coals being sent direct to Suez and Aden, &c., the detention of steamers at Suez and Alexandria would be avoided, four or five days would be gained in the transmission of passengers and mails, and the expenditure in the price of coals would be much reduced.

The Author again acknowledges his obligations to the able statements of Mr. Maclaren's paper of 1825, connected with this subject, and now quotes that author's opinions and those of the writer in the Foreign Quarterly Review of 1836, as to the feasibility of the proposed measure :—

“ Yet it is certain that the project must not only
 “ have been practicable but easy, since it was accom-
 “ plished in early times by men who were unpro-
 “ vided with many of those resources which modern

“ art supplies. In fact, when the ground is explored
 “ the supposed difficulties vanish, and we discover
 “ that Nature has furnished such singular and un-
 “ expected facilities for establishing a water com-
 “ munication between the two Seas, that she has left
 “ little for man to do to complete her work.”—
 MACLAREN, *Jamieson's Journal*, 1825, p. 274.

“ Were European civilization and a regular Go-
 “ vernment permanently re-established in Egypt,
 “ the undertaking would be found not only practi-
 “ cable but easy ; so great, in fact, are the facilities
 “ which the ground presents, that though the Canal
 “ (taking the magnitude of its section into account)
 “ would certainly be the largest that exists, the ex-
 “ pense would be considerably less than that of
 “ some small works of the same kind executed in
 “ the west of Europe.”—*Ibid.* p. 290.

“ There is little doubt that if the French had
 “ remained in Egypt, and especially with Napoleon
 “ at the head of the Government, they would have
 “ carried their project (of canals) into effect. The
 “ expense, compared with the magnificent result, is
 “ so trifling, that the wonder is that it has not been
 “ carried into effect before now, either by a com-
 “ pany having the support of Mahommed Pacha, or
 “ by the Pacha on his own account.”—*Foreign*
Quarterly Review, 1836, p. 362.

“ A glance at the map which accompanies the
 “ Topographical Survey of the French engineers is
 “ quite sufficient to demonstrate with what facility
 “ and at what moderate expense a ship's canal
 “ might be constructed from the Red Sea to the
 “ Mediterranean.”—*Ibid.* p. 368.

FROM THE MONITEUR,
(THE OFFICIAL PAPER OF FRANCE,)

6th July, 1855.

THE CUTTING OF THE ISTHMUS
OF SUEZ.

THIS undertaking, one of the grandest and most useful of the age, has for some time attracted a considerable share of public attention. There is but one opinion as to its immense results, but the question of the track has been a subject of discussion, which, in the absence of authentic documents and an exact knowledge of the localities, may mislead public opinion.

Two tracks have been proposed : one *direct*, which is to unite the two Seas by a Canal in a straight line from Suez to Pelusium ; the other *indirect*, which, starting from Suez, joins the Nile below Cairo, and terminates at the port of Alexandria.

In the eyes of all who are acquainted with Egypt the direct track alone appears practicable, the indirect track however has recently found its advocates in some European journals ; the following particulars, collected on the spot, will enlighten public opinion upon this point.

In the first place there is a difference of length between the two tracks, which is not unimportant. The direct track being the shortest, would certainly

not, of itself, be sufficient to give it the preference, especially if the other were both most economical and most advantageous ; but it appears that besides having the advantage of being much shorter, the direct track also has the recommendations of being more economical, more advantageous, and more easy of execution.

1st. The indirect Canal has to cross the Nile, and this condition is almost impossible to be carried out. The crossings of rivers are attended, as is well known, with difficulties, even when there is only a draught of water of 2 to 3 *met.*: what would they be for a Canal which is to be 8 *met.* deep ? And even one of the most decided partisans of the indirect track has not hesitated to declare frankly, considering this immense obstacle, which alarms but does not discourage him : “that the maintenance of such a depth presents difficulties which have never been surmounted nor even attempted.” It is true that at first the help of the barrage was reckoned upon in risking the crossing of the river ; but this barrage can only serve at the low waters during four or five months of the year, at the time when the lands are irrigated to prepare for the summer crops ; the reserved waters of the Nile will never, even at their *maximum*, be more than 4 to $4\frac{1}{2}$ *met.*, which is very far from 8 *met.* Above the barrage, at the point where the ships are to cross, the breadth is 2000 *met.* and if a transverse channel were dug there, how could it be prevented from filling with alluvium and mud ? During the increase of the waters, how could a current of five miles an hour, be crossed by sailing vessels against the wind blowing from the east and south ?

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the flow of all the waters into the Lake which is destined to receive them will be prevented. Passing through the Lake, as the railway does, seas of mire will be met with, so much dreaded on the Pelusiac coast. It has already been necessary to raise again and again the embankment of the railway which was disappearing in the Lake, and for three years it has been necessary to labour unceasingly at the repairs which are continually required ; what will it be when a dyke must be constructed at least 6000 *metres* in length, to heights of 7 to 8 *metres*, without knowing where to procure the necessary earth for these embankments ?

3rd. The indirect Canal cannot terminate in the port of Alexandria without causing still greater confusion there than it causes in the Canal works. In the first place the port of Alexandria is not *immutable*, as has been supposed. It has not escaped the action of the ground swell, which has choked it with sand to a good third of its extent. The part of the port which has been selected is frequently agitated by the north-west winds, and the surf is then so violent in rough weather, that even small craft dare not approach it. The rock is found there at a small depth below the sea, and as it would be necessary to extend the dykes of the Canal to 250 *metres* into the harbour, to obtain a draught of water of 7 *met.*, 50 to 8 *met.*, the rock would have to be excavated under the water. Add to this that in this direction all the grand magazines and all the Government works would be encountered ; there is not the least free space between the railway and the Mahmoudieh canal. But let us suppose all these difficulties overcome, there are

others which the Canal raises, and which it multiplies the more it is employed. The port of Alexandria, the only military port of Egypt, is then besieged by hundreds of merchant vessels, and by the sailors of the whole of Europe. Let there be a contrary wind ever so slight, or some requisite repairs to the locks, and that the movement is arrested, just fancy the impediment, without taking into account the political dangers of such an accumulation. Moreover it is not only at Alexandria that this intolerable inconvenience would arise ; it might happen, in consequence of accidents easily to be foreseen but impossible to be prevented, that Egypt should see all on a sudden 8 to 10,000 foreign sailors stationed on a point of her territory, because the forty vessels at least which traverse it every day have been forcibly detained at some part of the passage during twenty or five and twenty days consecutively.

To these conclusive reasons, it would not be difficult to add others ; but these must be sufficient to warn unbiassed minds against the indirect passage.

The inconveniences, or rather the impossibilities of the indirect track, become more striking when compared with the conditions of the direct track and its incontestable advantages.

1st. To begin with, the direct track is only about one third the length of the other. That would be 400 *kilometres* long, and the direct track is only 155, which would be reduced to 120, as will be seen. Near about the middle of the Isthmus, the Bitter Lakes are met with, which give 18 *kilometres* of navigation ready made, and not requiring a single turn of the shovel, as the Viceroy's engineers say,

and 18 *kilometres* in addition are three parts excavated by nature itself; 120 *kilometres* therefore remain, that is to say, 30 leagues at the most.

2nd. The direct track is the easiest. There are only two salient points in the entire Isthmus that it is necessary to traverse by partly turning them; one, the Serapeum, which, according to the levels checked in 1853, is 16 *met.*, 5950 high; and the other El Guisr, which is 11 *met.*, 6300. With the depth of the Canal, this would make a cutting of 20 or at most 24 *metres* at some points. There is certainly nothing in such a work to terrify our engineers.

3rd. The direct track is the most natural. The Isthmus is traversed by a longitudinal depression, formed by the meeting of the two plains descending with an imperceptible slope, the one from Egypt, the other from the frontier hills of Asia. The Bitter Lakes, filled with the waters of the Arabian Gulf by the action of the tides only, may easily form a reservoir which, with a surface of 280,000,000 *square metres* by a rise of 2 *metres* of moving waters, would not receive less than 560,000,000 *cubic metres*, for the service of the Canal, below the water line at the level of the two Seas. Lake Timsah, situated at about an equal distance from Suez and Pelusium, is like an inland port where ships can be revictualled and repaired. Moreover, by another favour of nature, towards Lake Timsah a second not less remarkable hollow abuts perpendicularly on the longitudinal depression, it is that of the Wady-Tomilat (the fertile Goshen of the Bible). This hollow still receives the overflowings of the Nile for a great part of its length, and forms the natural track of a communication start-

ing from the river and joining, at the central part of the Isthmus, the line of maritime navigation which would be established between the Arabian Gulf and the Mediterranean.

4th. The direct track is the most useful. It serves at the same time the interests of commerce in general and the political interests of Egypt and the Ottoman Empire. It will require but little to maintain it, and as there will be very few works of art, navigation will not be exposed to those interruptions which it would have to dread on the indirect track.

To these evident advantages of the direct track, to ~~these~~ relative facilities which had attracted the attention of the sovereigns of Egypt, of Amrou and Mustapha III. for example (see Lebeau, *Histoire du Bas-Empire*, tom. XII. p. 490. and the *Mémoires du Baron de Tott sur les Turcs*. pts. III. and IV), before attracting that of the nineteenth century, there is but one objection, and it is this :—

It is impossible, they say, for large ships to approach Pelusium ; and the direct Canal is chimerical, because it cannot open into the Mediterranean.

This oft-repeated objection is but specious, and cannot stand before an examination of the facts. The entrance to Pelusium is certainly a difficult and costly work, but it is perfectly practicable, and engineers have overcome very different obstacles with resources much inferior to those now at their command.

It is well in the first place that it should be known that the level of the two Seas, excepting the difference of the tides, which are pretty high at the south in the Red Sea, and almost nothing at the north in the Mediterranean, is perceptibly the same. The com-

mission of 1799 had found for the Arabian Gulf an elevation of 9 *met.* 90 ; but its labours, performed in the midst of all the dangers and disturbances of war, had not been verified, and the genius of Laplace resting upon accurate theoretical views, had formally denied the possibility of such a depression within a distance of scarcely thirty leagues. Afterwards, towards 1840, some English officers had proved by the barometer and the boiling water process that there was no difference of level ; and in 1843, Prince Metternich, having been informed of these labours, sent instructions to Egypt to induce Mehemet Ali to interest himself in the grand undertaking of the cutting of the Isthmus : his dispatch is still in the Archives of the Austrian Consulate at Alexandria. In 1847 a commission of French engineers, sent out by M. Paulin Talabot under the direction of the learned M. Bourdaloue, and assisted by Egyptian engineers directed by M. Linant, chief engineer to the Viceroy, put the fact beyond all question, and M. Paulin Talabot had the honour of stating it in a memorial that has become famous. Our Academy of Sciences bestirred itself for the honour of the ancient Egyptian commission. M. Sabatier, Consul general of France, asked the Viceroy for a fresh verification, which M. Linant was charged to undertake in 1853, and which confirmed, saving an insignificant variation, the labours of 1847.

So that the considerable super-elevation of the Red Sea cannot be reckoned on for facilitating the approaches from the Mediterranean at the other extremity of the Canal ; there is only the difference of the tides.

As a depth of 7 *met.* 50 to 8 *met.* is not found before Pelusium or Tineh, but at a distance of 6000 *met.* into the sea, it is assumed that it is practically impossible to prolong the jetty of the Canal to that distance, because the waters are but *liquid mud*, and that *clouds of earth* would interfere with the progress of the vessels and the solidity of the works.

This is a complete mistake.

Because Herodotus has said, that the Delta is a present from the Nile, his inaccurate assertion has been repeated without verifying it, and his metaphor has passed for an incontestable truth. But it is an absolute fact, and it is only necessary to ask those who have been at Pelusium, that the water there is as limpid as at Alexandria or Jaffa. The banks of *travelling mud* seen by Admiral Sir Sidney Smith have no more reality than the *present from the Nile*, and for the twenty years that these coasts have been traversed in every direction by steam boats, no one has ever met again with those muddy banks. The truth is, that the waters of the Nile, which, at the time of the inundation are distinguished for more than ten leagues into the sea, carry far out into the Mediterranean and deposit in its depths, the masses of earthy matter which they hold in suspension (near $\frac{1}{80000}$), and which do not reappear on the coasts but in imperceptible quantities ; the truth is, that a handful of sand may be taken up from the sea beach, at Pelusium, without finding the least particle of mud. The Viceroy's engineers have proved that the coast, from El-Arish to Tripoli, is pure sand, and the soundings taken along the shore give the same result. Far from the Nile forming accretions at Pelusium,

it is an axiom now admitted by science that the muddy or sandy deposits observed at the mouths of rivers are entirely owing to matters brought by the tide. The rivers have no part therein ; and the excellent observations made by most able hydrographers at the bay of Mount St. Michael, at the mouths of the Scheld, the Meuse, the Rhine, the Yssel, have superabundantly proved it. The accumulations of sand at Pelusium and Suez, like the whole Isthmus, have been formed by the maritime deposits of the Mediterranean and the Red Sea. The thorough investigation of the motion of the waves has demonstrated that the bars of rivers are due to the ground swell alone. The Nile, therefore, has no influence upon the approaches to Pelusium, as Herodotus supposed, and as is still the common opinion ; and this is so true, that for 20 *kilometres* above its mouth there are accretions of mud, while below there is nothing but sand. Finally the accumulations of sand are more considerable in proportion as the waters of the river are less abundant.

Setting aside from the question the hypothetical assertions, it remains therefore incontestable that the only difficulty at Pelusium, is the length of the jetties in the sea. Pelusium, with its ruins, is at the same point where Strabo saw it, where the Egyptian commission saw it, which found the twenty stadia of the Greek geographer between the shore and the town quite correct. But are jetties of a league and a half into the sea possible, or are they indeed a work that cannot be executed ? The answer to this question is easy : a hundred years ago, the Hollanders, not so

rich and not so skilful as we are now, although quite as bold, erected at the Cape, in the bay of the Lion, at a depth of 16 *met.*, in spite of the most frightful tempests, a dyke of 8000 *metres*, that is, a work of at least four times the extent of that required for the entrance of the Canal at Pelusium.

As for the harbour of Suez, the work there would be comparatively trifling because it is sheltered from all the winds, excepting that from the south-east, and ships keep the sea there very well, as is proved by the English Magazine corvette, moored there for two years, without sustaining any damage.

What is to be deduced from these observations?—That it is possible to make a canal 100 *metres* wide from Suez to Pelusium, with a draught of water of 8 *met.*, below low water in the Mediterranean, with parapets, towing path, &c. and available for the passage of screw and paddle frigates, and vessels of 1000 to 1500 tons burthen, and that this canal, following the straight line between the two Seas is the only practicable one, as it will be one of the grandest and most useful works ever performed by man.

To conclude, this track is the only one that the prince who now rules in Egypt will allow. Well informed himself in nautical arts and sciences, the inheritor of the policy of Mehemet Ali, which he approves while he practises, he has declared in dictating his own terms for the firman of concession, that he would have the shortest and least expensive track, and one that would be available for the largest ships. It is not in the scheme of an inland canal that the real junction of the two Seas consists; the indirect canal cuts through Egypt, and not the Isth-

mus ; its extent is not only tripled, but the cost of execution and maintenance are enormous, and the existence of a canal constructed upon these conditions would be always uncertain and precarious while the direct track, which unites so many advantages, has none of these drawbacks.

HÔTE.

THE END.



PANAMA MARITIME CANAL.

EL BEY.

GYPT.



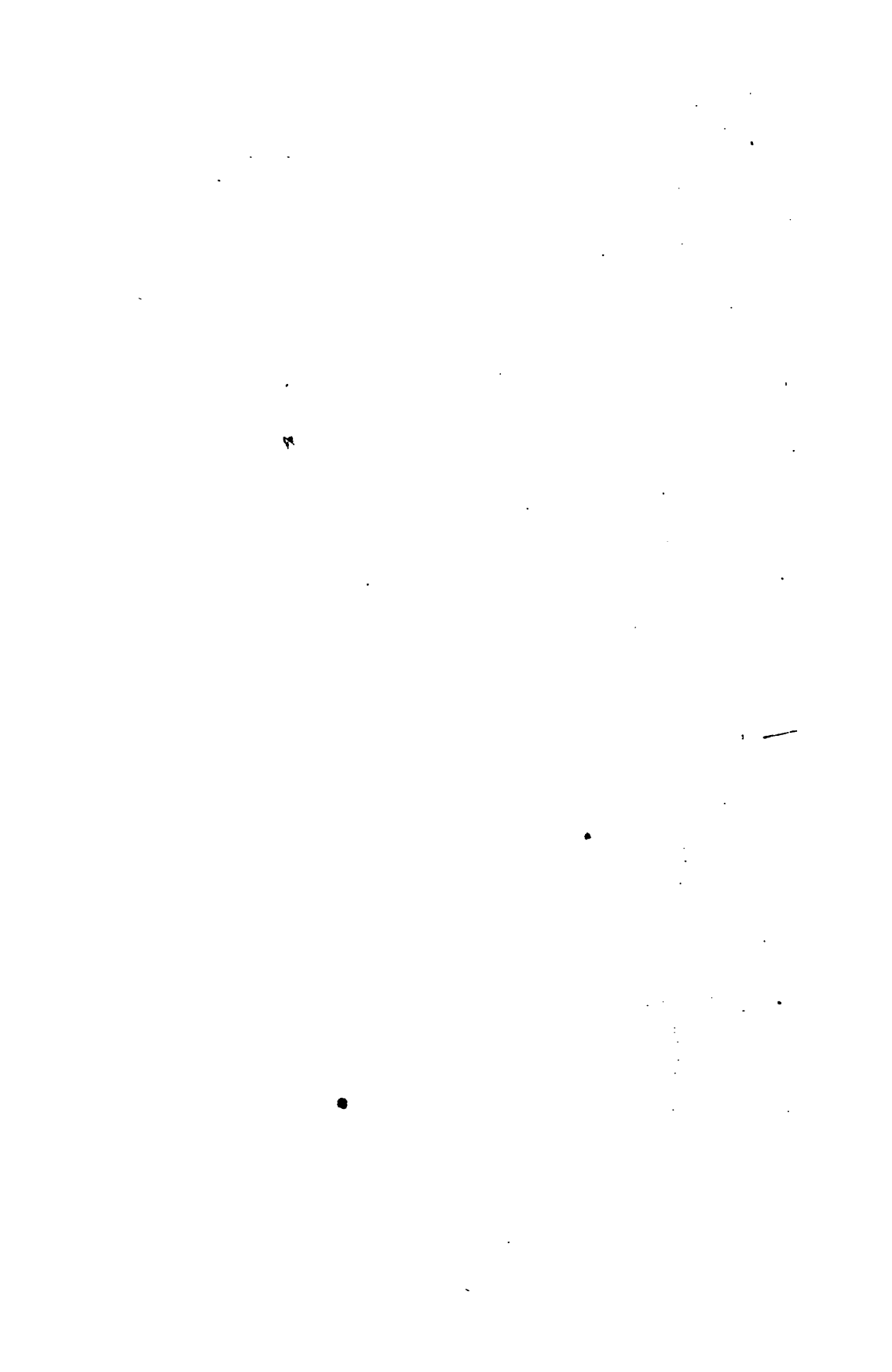
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| 5 SALIEH | 29 PORT OF LAKE TIMSAH |
| 6 ABQU TAF | 30 SHEIK ENNEDEH |
| 7 TELL E. MA | 31 BAR OF SERAPEUM |
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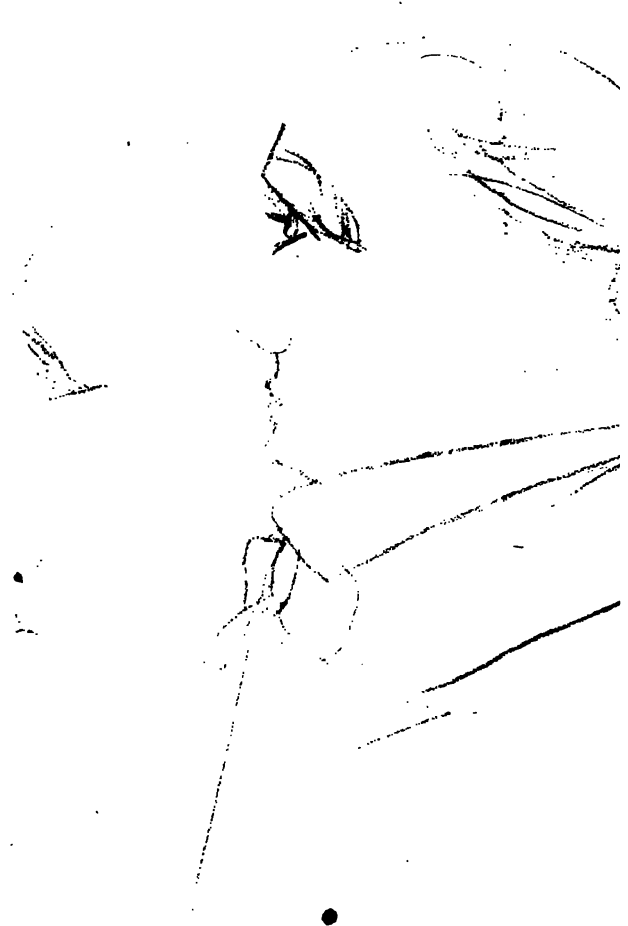
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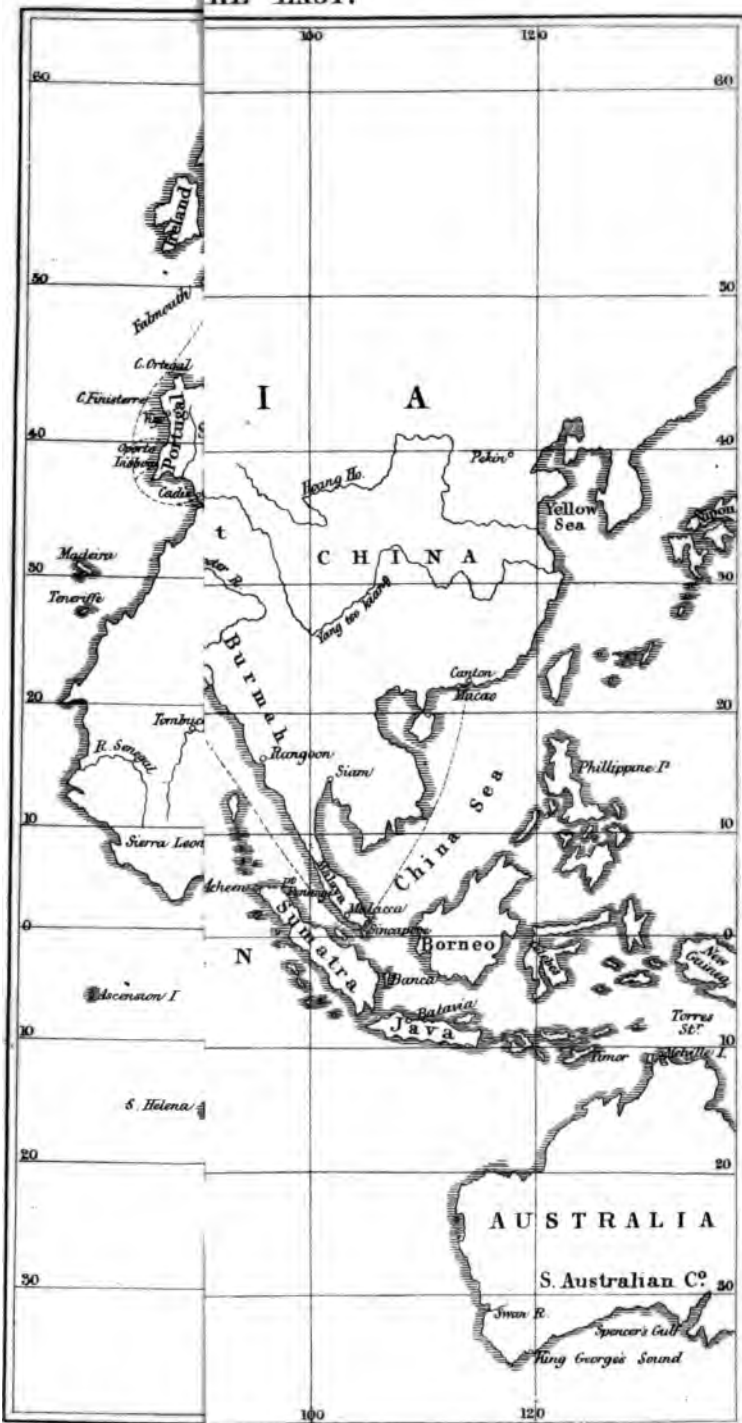
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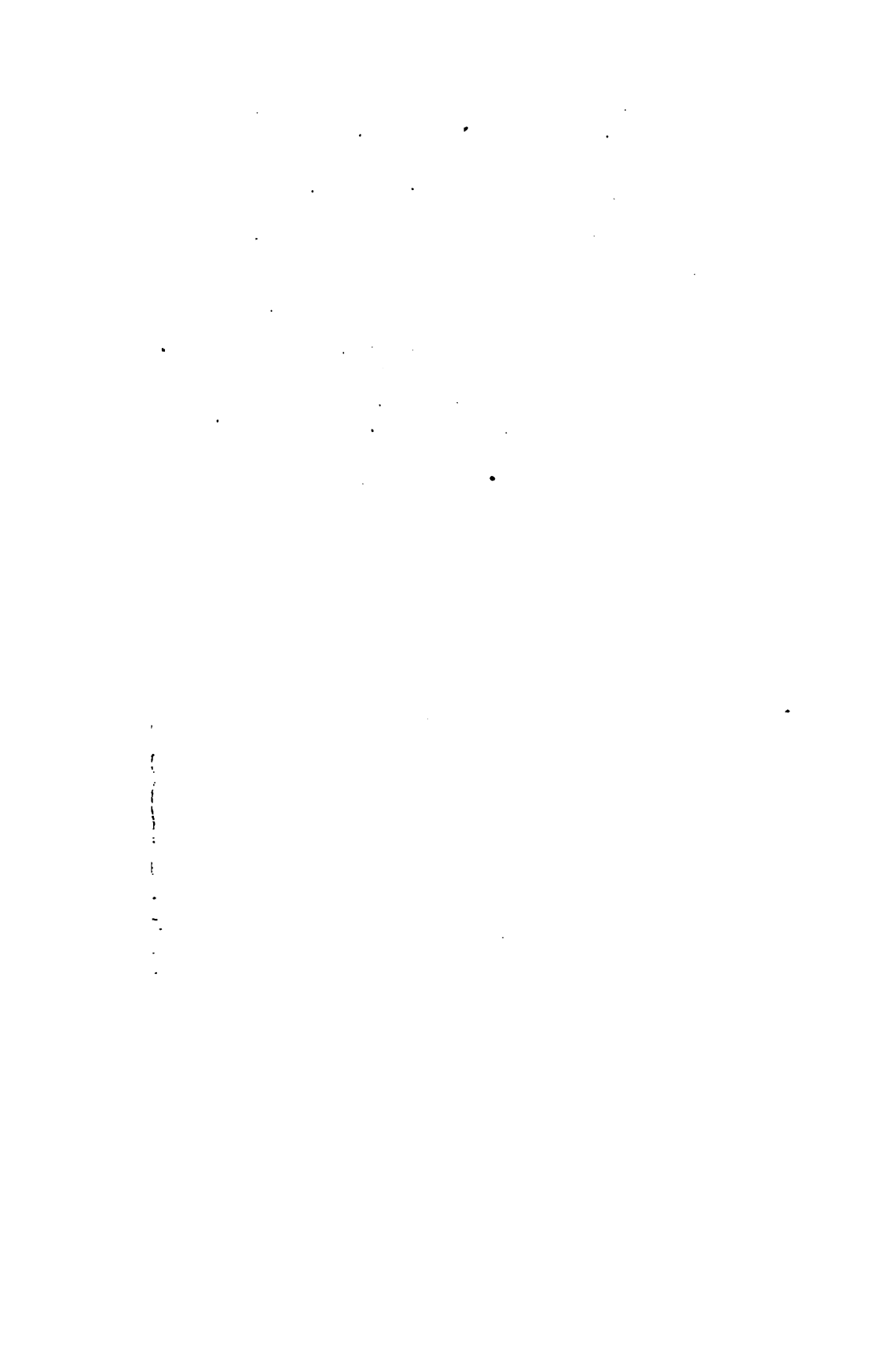
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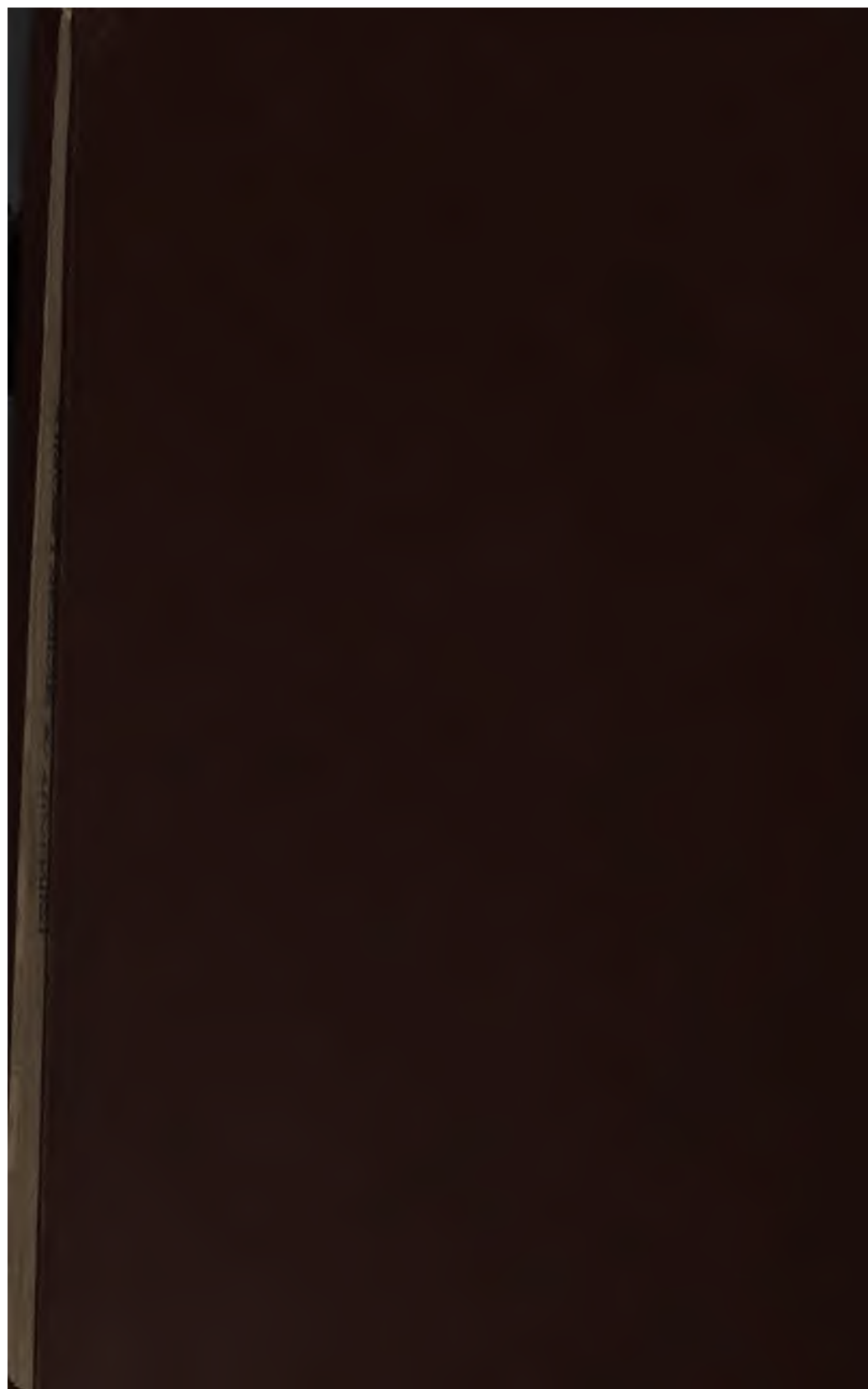


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